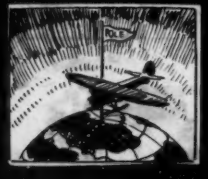
The REFINER
AND NATURAL GASOLINE MANUFACTURER



CHESTNUT & SMITH
CORPORATION
Tulsa, Oklahoma

6000 tons of Braun Heat Exchangers -

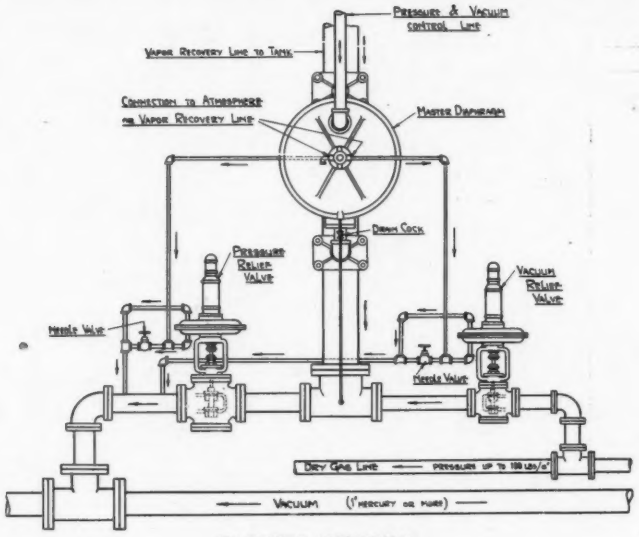
- manufactured during the last two years and *now* operating in refineries - and absorption plants, all over the world - - - - substantial evidence *that* BRAUN exchangers mean - - - - - - - - "Less cost per B·T·U transferred"

C. F. BRAUN & CO.
Manufacturing Mechanical Engineers
ALHAMBRA, CALIFORNIA
TULSA • DALLAS • NEW YORK

BRAUN

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the act of March 3, 1879.

The NEILAN VAPOR RECOVERY REGULATOR SYSTEM



(PATENTS PENDING)

Insures the Complete Recovery of All Tank Vapors

Extremely supersensitive and reliable, and accurate to 1/10th of an inch of water, the Neilan Vapor Recovery Regulator System assures an exceptionally high degree of efficiency in service.

The system is extremely simple and once placed in operation requires no further adjustments of any nature. It will operate efficiently for several years without repairs.

All materials used throughout resist corrosion from hydrogen sulphide gas and other sulphur compounds. The valves will not chatter.

The Neilan Vapor Recovery Regulator System consists of a pressure relief valve and a vacuum relief valve, both operated from pilot valves connected to a master diaphragm. It will maintain atmospheric pressure in tanks and will not vary more than 1/10th of an inch of water; regardless of pumping in, pumping out, or expansion and contraction due to temperature changes.

The pressure relief valve will permit vapors to pass into the vacuum line at atmospheric pressure. The valve opens on the slightest increase in pressure above atmosphere, and will be fully open at 1/10th of an inch water pressure.

When pumping out of tanks the vacuum relief valve opens at the slightest vacuum and allows natural gas to pass into the tank.

No reducing regulator is required on the line to the relief valve for pressures up to 100 pounds.

Descriptive circular sent on request.

NEILAN, SCHUMACHER & CO.

641-651 Santa Fe Avenue, Los Angeles, California

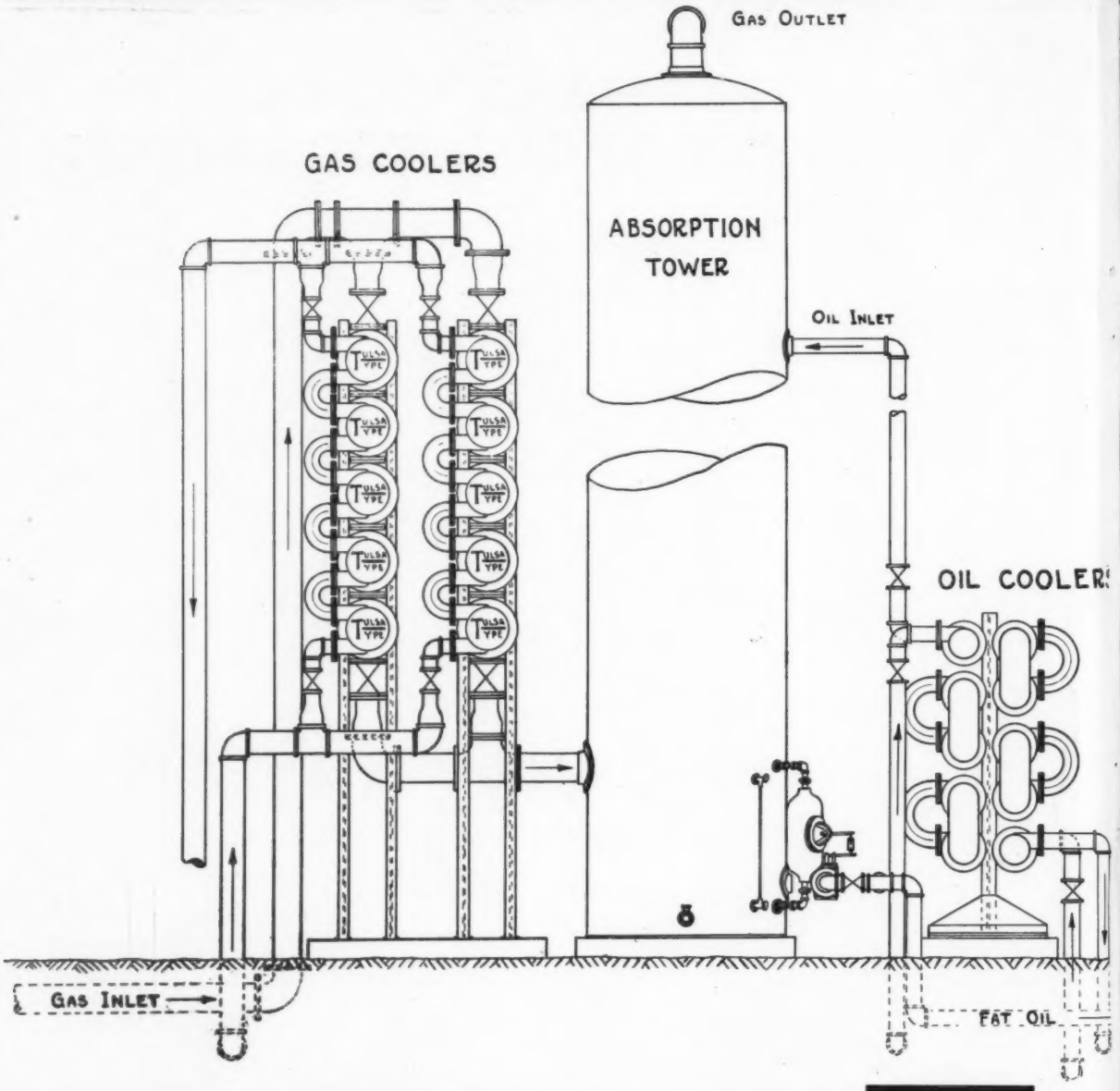
Representatives:

Maintenance Engineering Corp., 2000 Harrington Street, Houston, Texas

NEILAN

C. F. Camp Co., 221 East Archer St., Tulsa, Okla.

"You Can Be Sure of Neilan Products"



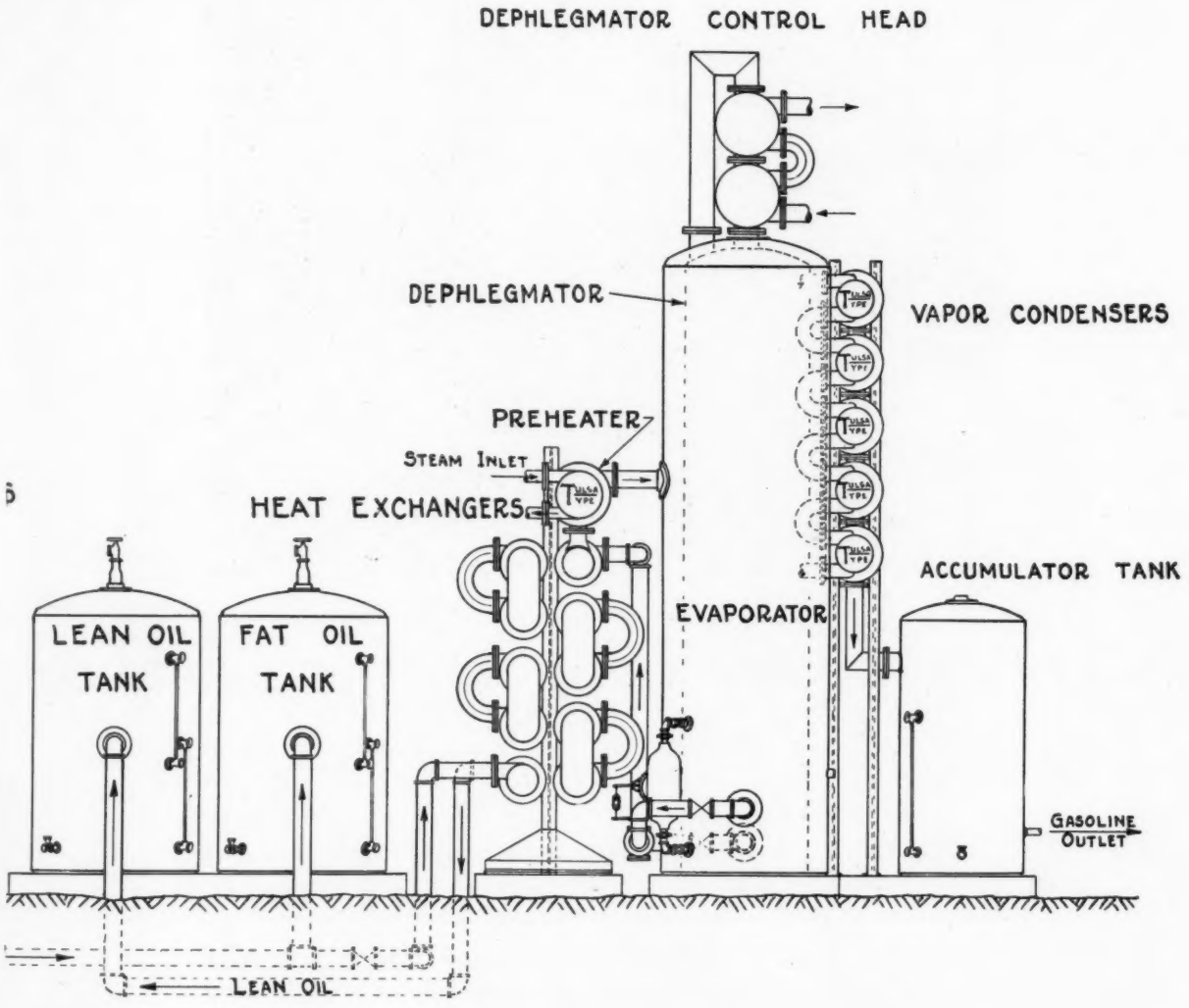
THE 1928 MODEL TULSA TYPE EMBOD

HIGH THERMAL EFFICIENCY·LOW PRE
COMPACT YET IN EVERY

Different combinations made to take
make use of equipm

TULSA BOILER & MA

2020 South Union



GASOLINE PLANT

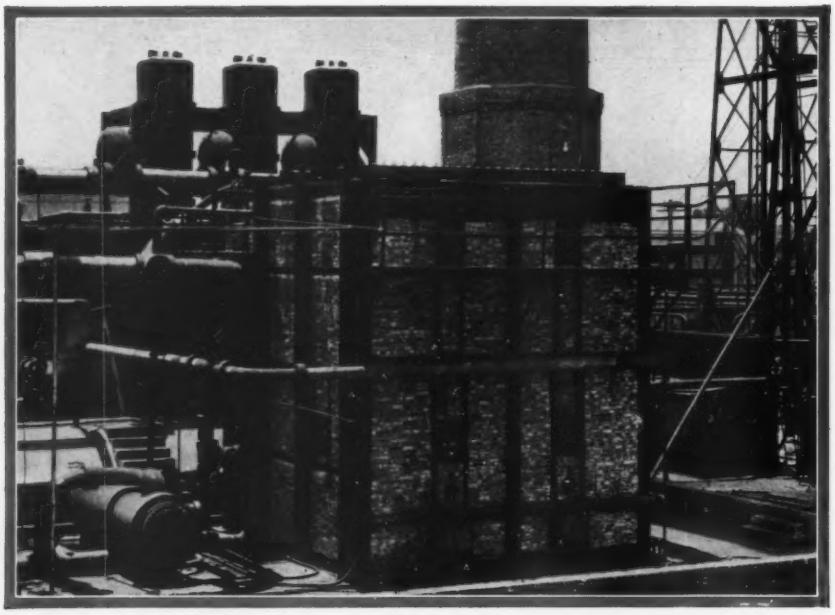
YING

SSURE DROP-CARE FREE OPERATION
PART FULL SIZE PLUS

care of unusual conditions or to
ent already in use

CHINERY COMPANY

Tulsa, Oklahoma



A Typical Foster Tube Still Performance

This Foster Tube Still, operating at 1500 barrels daily and taking 76 per cent overhead, has shown 72 per cent overall efficiency on several test runs.

It replaces four 400-barrel shell stills at a considerable saving of space, attendance and fuel, and was installed at small alteration cost on a portion of the foundation of the old shell stills.

Your own refinery operations may permit similar economies through the use of Foster Wheeler apparatus. Write for full information.

FOSTER WHEELER CORPORATION, 165 Broadway, New York
A consolidation of Power Specialty Co., and Wheeler Condenser & Engineering Co.
Works: Carteret, N. J.; Dansville, N. Y.; Newburgh, N. Y.

Branches in principal cities

FOSTER WHEELER

FRACTIONATING TOWERS HEAT EXCHANGERS
STEAM JET AIR PUMPS SUPERHEATERS
TUBE STILLS VACUUM PUMPS
WATER COOLED FURNACE SURFACES
BRASS AND COPPER TUBING AND PIPE

AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

Mention Where You Saw the Advertisement

Why do Leading Refiners Prefer Laclede-Christy Flat Arches?

Because—

1. No loose pieces—entire structure bolted together, making one unit—physically impossible for any section or piece to fall in.
2. Bolted castings provide positive spacing of tile, eliminating strains which are main causes of spalling.
3. Easy to erect—photograph above shows simplicity of supporting structure and provision for easy hanging of tile.
4. And last, but not least, Laclede-Christy Arch Tile—the highest grade material for this purpose. Costs no more than ordinary tile.

They Do Last Longer!

Write LACLEDE-CHRISTY, St. Louis, U. S. A., *for detailed information*

Mention Where You Saw the Advertisement

PARTNERS

in Fast, Close Fractionation —Bubble Towers and Automatic Control

"Fractionating practice has made a definite trend toward the bubble tower with automatic control," members of the Petroleum Division of the A. S. M. E. point out.

Bubble towers operated with Brown Automatic Temperature Control Pyrometers have played a prominent part in establishing this trend. Brown tower control makes practical sharper endpoints, with more throughput. Greater flexibility through electrical design. Get catalog No. 15. THE BROWN INSTRUMENT CO., 4413 Wayne Ave., Philadelphia, Pa.

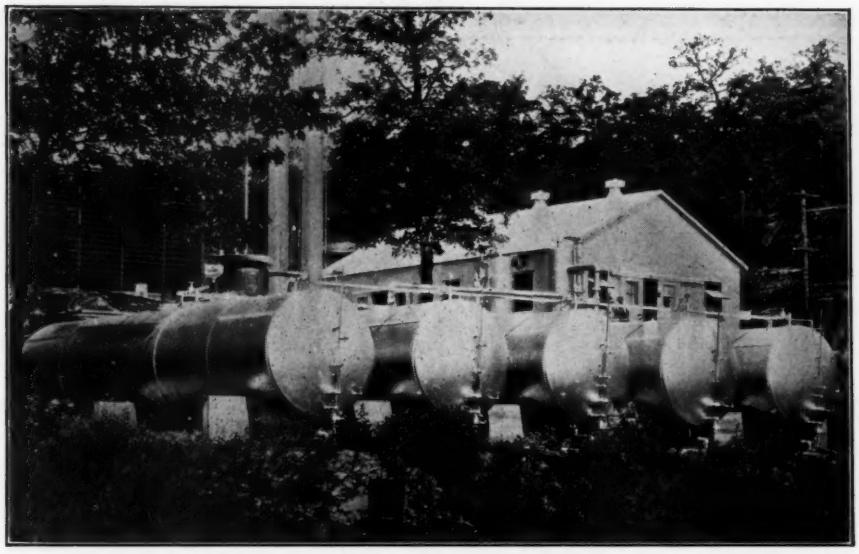
Branch Offices in 18 Principal Cities.

Pyrometers
Automatic Temperature and Pressure Controls
Flow Meters
Recorders
CO_2 Meters
Pressure Gauges
Vacuum Gauges
Liquid Level Gauges
Draft Gauges
Thermometers
Tachometers
Hygrometers

Brown Automatic Temperature Control

"To Measure is to Economize"—Pascal

Charles Page Interests—Bruner Station nr. Sand Springs, Okla.
Tanks, Bridges and Metal Buildings coated with Bitulumin.



"Southern Exposure" HARD ON PAINTS

Sun's Ultra Violet Rays Cause Rapid Surface Breakdown—

Aluminum Paints Largely Immune

Correctly made aluminum paints like Bitulumin are largely immune to destructive ultra violet rays. They will outlast the best oil and zinc paints by two to one.

Bitulumin forms a protective coating of tiny aluminum flakes like shingles held firmly together by its moisture proof liquid vehicle. It is both light proof and weather proof.

Because Bitulumin deflects approximately 86% of sun rays it makes for cooler surfaces and in the case of tanks reduces evaporation.

Bitulumin although widely used for painting oil storage is equally efficient on tank cars, metal buildings, refinery equipment, still towers, water tanks, bridges, etc.

Bitulumin, put up in double containers to insure fresh mixing, is manufactured by Hill, Hubbell & Company, manufacturers of a special line of paints and protective coatings for the oil industry.

HILL, HUBBELL & COMPANY

Manufacturers of
Highest Grade Oil Industry Paints and Pipe Line Coatings
Factories: SAN FRANCISCO and TULSA

District Offices:
SAN FRANCISCO, SEATTLE, LOS ANGELES, TULSA, PORTLAND, HOUSTON, NEW YORK, BALTIMORE

Mention Where You Saw the Advertisement

SUNOCO

Merry Christmas

Last Christmas we suggested as an ideal gift for your gasoline plant,

Sunoco Absorption Oils
630 *and* 670

We promised, if you would use these oils, you would give yourself a nice present in the way of increased yields and consequently larger dividends.

If you forgot our suggestion, why not order a car now and use the Sunoco Oil designed for YOUR plant consistently throughout the coming year.

Merry Christmas and a Happy New Year with SUNOCO.

SUN COMPANY

Petroleum Bldg., Tulsa, Oklahoma

Refineries at

Marcus Hook, Pa. Yale, Oklahoma Toledo, Ohio

Mention Where You Saw the Advertisement

TO
EVERY
REFINERY
MAN AND
GASOLINE
MANUFACTUR-
ER WE SEND OUR
SINCERE WISH FOR
A MERRY CHRISTMAS
AND A PROSPEROUS
NEW YEAR—WE WANT
TO THANK THOSE WHO
HAVE HELPED TO MAKE
OUR PAST YEAR'S BUSINESS
BETTER THAN EVER AND TO
EXTEND AGAIN TO THE ENTIRE
INDUSTRY AN INVITATION TO
CALL ON KAW WHENEVER ANY
KIND OF REFINERY EQUIPMENT IS
NEEDED—WHETHER IT BE STANDARD
EQUIPMENT OR A SPECIAL SPECIFICA-
TION JOB WE ASSURES ATISFACTION
BOTH IN WORKMANSHIP AND DELIVERY
WRITE, WIRE
OR PHONE
FOR MONEY-
SAVING
PRICES

KAW STEEL CONSTRUCTION CO.

General Office and Plant: 1st and Walker Ave., Kansas City, Kansas

HORIZONTAL TANKS — CONDENSER BOXES
RUNDOWN TANKS — STORAGE TANKS
STACKS • • • BUBBLE TOWERS • • • STILLS

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

Without auxiliary equipment Jenkins Cracking Plants will produce maximum yield of gasoline at lowest cost from—

Crude Oil

Topped Crude

Gas Oil

Residium

GRAVER Corporation *Founded 1857*

EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO Steger Building | TULSA Atlas Life Bldg. | HOUSTON West Building

Write any office for descriptive bulletin

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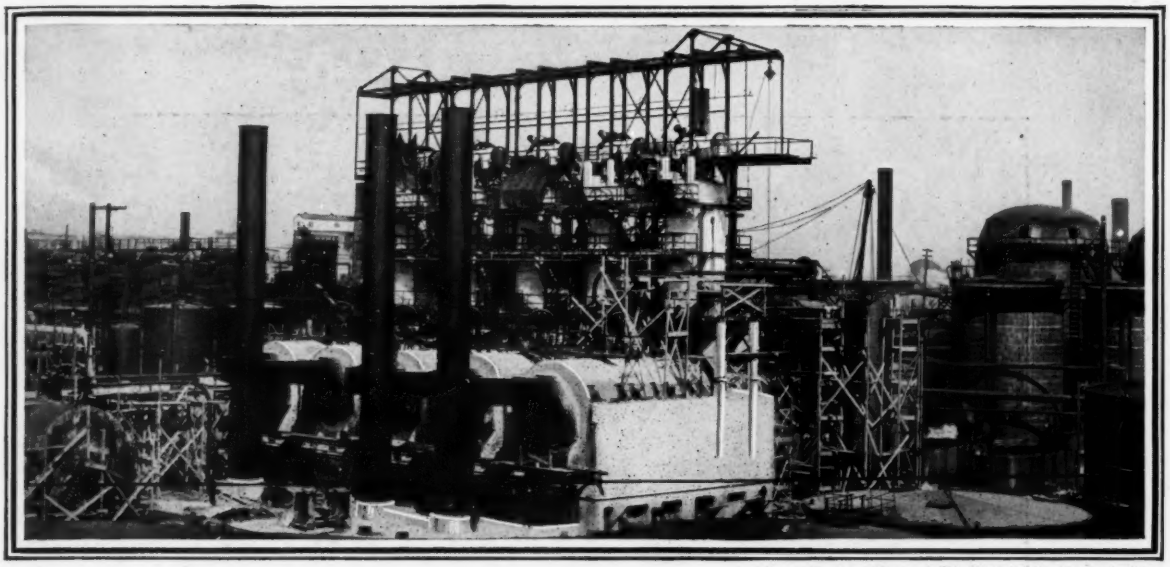


Construction picture Battery A, Tide Water Oil Co., Superex Insulation

Get the answer to the still and boiler setting problem

OIL engineers have struggled for years with the problems of air infiltration, buckling of walls and reduced efficiency of still and boiler settings.

Now these serious difficulties have been overcome. New materials are available which are not subject to the old disadvantages.

Through the work of thoroughly experienced engineers there has been developed the Johns-Manville method of insulation for still and boiler settings. Wherever there are refineries and plants you find the most progressive field engineers turning to this method.

The chief engineer of one of these producers wrote recently, "Your latest combination of materials eliminating the red brick wall on the boiler settings has proved more satisfactory than we hoped. It has stopped air infiltration and saved fuel."

There are undoubtedly many improvements that you would like to check up, on which Johns-Manville engineers will be glad to give you their experience.

For your convenience there is a coupon at the right. Sign and mail it, or drop us a line and we will see that you get full information.

JOHNS-MANVILLE

Oil Industry Department

JOHNS-MANVILLE CORPORATION, MADISON AVE. AT 41st ST., NEW YORK CITY
Branches in all large cities. For Canada: CANADIAN JOHNS-MANVILLE CO., LTD., TORONTO

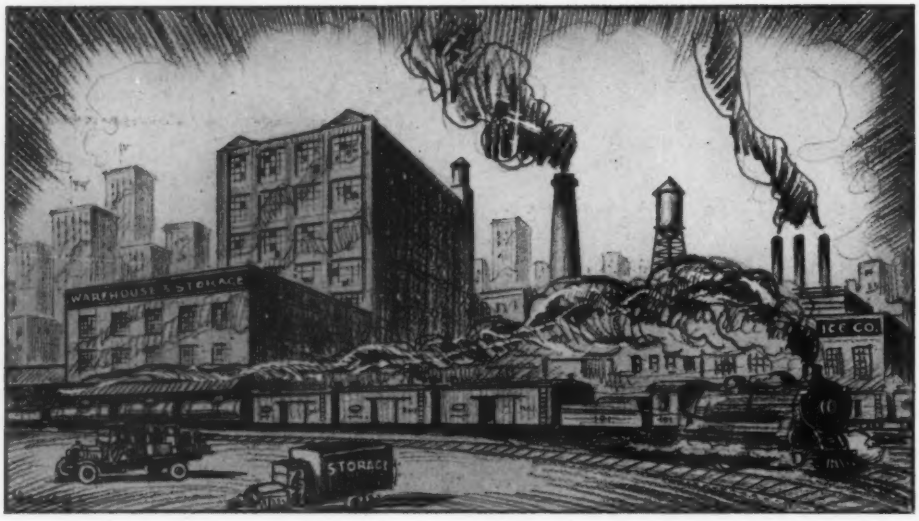
Johns-Manville Corporation, 292 Madison Ave., New York, N. Y.
Without obligation tell us your answer to the still and boiler setting problem.

Name_____

Firm_____

Street_____ R12

City_____ State_____



Held in Readiness

The utility of most things is governed both by time and place. Oil in a 55 is of no use to the speeding tourist who wants only a small quantity and wants it when the bearings are hot.

Water in a tank alongside the track is little help to the fireman who needs it on the grade. Gasoline is not often bought in tank car lots and even drinking water is often piped and held in storage awaiting the turn of the faucet.

Storage and transit, transit and storage. It is the thing which keeps business moving. Remove the service of tanks and reservoirs to business and there would be both confusion and stagnation.

Wyatts, closely in touch with the service of storage through their manufacture of tanks of all kinds, believes in the principle of being prepared for demands that arise.

The best of equipment, trained engineers and skilled workmen are held on tap at the big Wyatt plant in Dallas for any demand. It is a great reservoir for supplying quickly and with even flow the demands of all firms in the Southwest for tanks of every description.

Wyatt service is held in readiness. Call on it for any needs in the fabrication of metals.

Oil Tanks, Storage Tanks, Culverts, Smoke Stacks, Metal Products of all kinds. Refineries complete.

WYATT METAL & BOILER WORKS
DALLAS, TEXAS

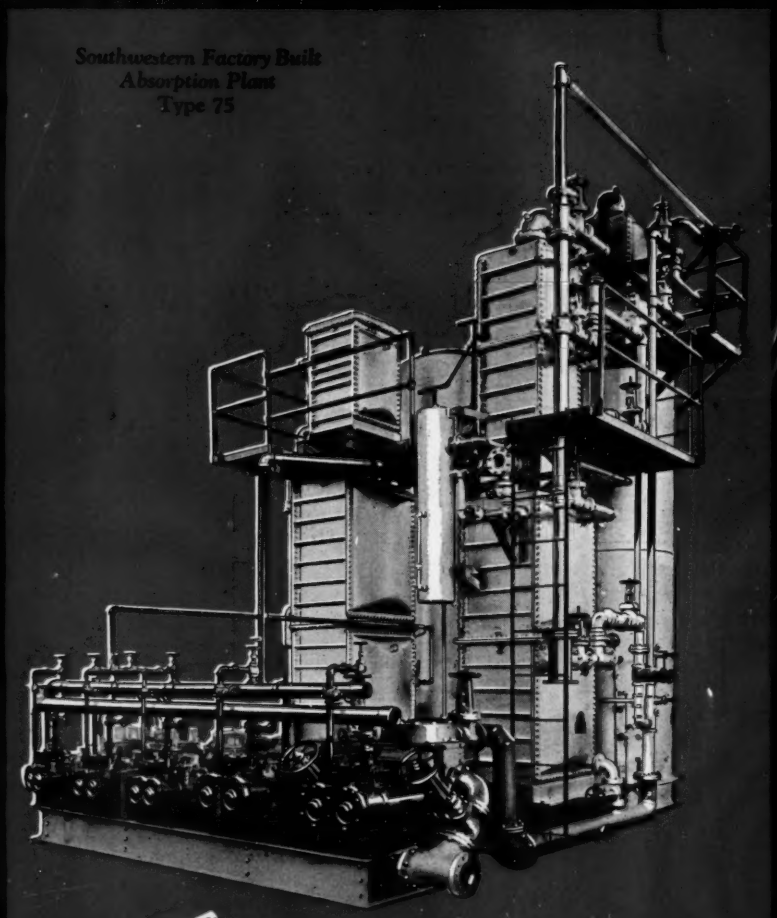
Mention Where You Saw the Advertisement

Two Famous 75's

The SOUTHWESTERN 75 Absorption Plant of 1927

...helped to win the fight for low gasoline manufacturing costs.

Quick installation, high recoveries and low operating costs are Southwestern Absorption Plant features.



Southwestern Factory Built Absorption Plant Type 75

The French 75 of 1914 helped to win the World War.

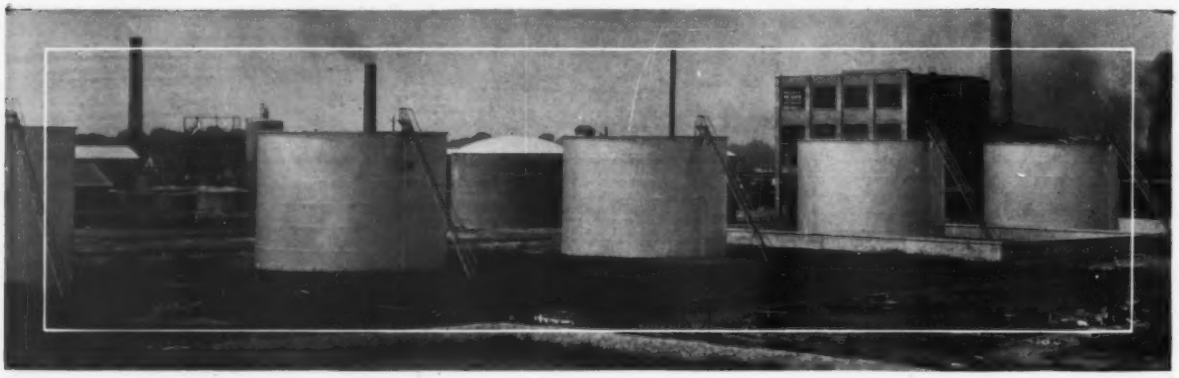
SOUTHWESTERN ENGINEERING CORP.

HOLLINGSWORTH BLDG.
Los Angeles, Calif.

Branch
Joplin National Bank Bldg.
Joplin, Missouri

and
90 WEST STREET, NEW YORK CITY

Branches
Western Bldg., Amarillo, Tex.
Mayo Bldg., Tulsa, Okla.



Group of 50-foot diameter working tanks at a refinery equipped with Wiggins Floating Roofs.

The economical working tank is the one equipped with a WIGGINS Floating Roof

FIRST COST of an oil tank (including the roof) is only one indication of its economy—usually the least important one. A tank on which the annual evaporation loss runs six or seven per cent or more is uneconomical at any first cost.

Stop Evaporation Losses

The Wiggins Floating Roof installed on any tank cuts evaporation losses to the vanishing point. The cost of the roof is outweighed by the savings it produces. On most working tanks it will pay for itself through such savings in a few months.

This roof comprises a floating deck and a means for sealing the narrow space between this deck and the tank shell. The unique feature of this seal—the distinctive Wiggins principle—is the use of a deep, narrow slot over the only oil surface ever exposed. The depth of this slot practically eliminates windage so that even when the oil is momentarily exposed the heavy vapor protects it from evaporation loss.

No operating expense

The saving in evaporation effected by a Wiggins Floating Roof is clear gain, for there is no operating expense. There are no pumps nor compressors to run, no piping lines nor recovery plants to operate. The roof moves up and down as the oil is pumped in and out, automatically blanketing the surface at all times.

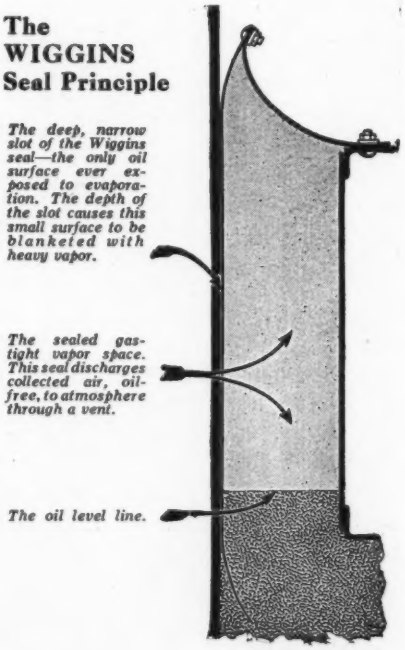
No fire hazard

Another reason for the economy of a tank equipped with this roof is the elimination of fire hazard. The loss from a single bad fire would buy many Wiggins Roofs Repeated demonstrations prove that fire cannot reach the oil stored under this floating roof.

Why not equip your working tanks with Wiggins Floating Roofs and get the benefit of these economies?

Quotations on request.

The WIGGINS Seal Principle


The deep, narrow slot of the Wiggins seal—the only oil surface ever exposed to evaporation. The depth of the slot causes this small surface to be blanketed with heavy vapor.
The sealed gas-tight vapor space. This seal discharges collected air, oil-free, to atmosphere through a vent.
The oil level line.

Our booklet *"Stopping Evaporation"* describes and illustrates the Wiggins Floating Roof and the economies effected by its use.

A new booklet *"The Wiggins Breather Roof For Standing Storage"* contains similar facts regarding this companion type of roof, designed for application on tanks used for standing storage.

These books will be sent to anyone interested in promoting economies in oil storage through stopping evaporation.

Chicago Bridge & Iron Works

CHICAGO.... 2463 Old Colony Bldg. DALLAS.....1655 Dallas Nat'l B'k Bldg.
NEW YORK..3102 Hudson Terminal Bldg. ATLANTA.....1046 Healey Bldg.
CLEVELAND. 2234 Union Trust Bldg. SAN FRANCISCO. 1051 Rialto Bldg.

WIGGINS FLOATING FOR WORKING STORAGE BREATHER FOR STANDING STORAGE ROOFS

R 12-Gray

Mention Where You Saw the Advertisement

Guardians of the Pipe Lines

Why Williams Valves Stand First

Where the smoke of thousands of chimneys tell of the restless activity of the world's mightiest industries you will find Williams valves guarding the pipe lines.

In the great steel mills of the Pittsburgh and Bethlehem districts—in the refineries—shipyards—railroads and central station plants valves are installed on merit alone. Here they know metals; here they know workmanship; here, where service is most severe, tests most scientific and records most accurate, Williams valves are installed BECAUSE THEY MAKE GOOD IN EVERY WAY.

Known generally as the extra heavy line of valves, men of experience also know that this extra material is so perfectly distributed and of such superior quality that Williams Valves are really the most economical in the long run.

Until you use Williams Valves you cannot appreciate how much they will contribute to the prosperous and economical operation of your plant.

They are made in many types and sizes to suit most every industrial or power requirement.

Our dealer in your territory can supply your needs promptly

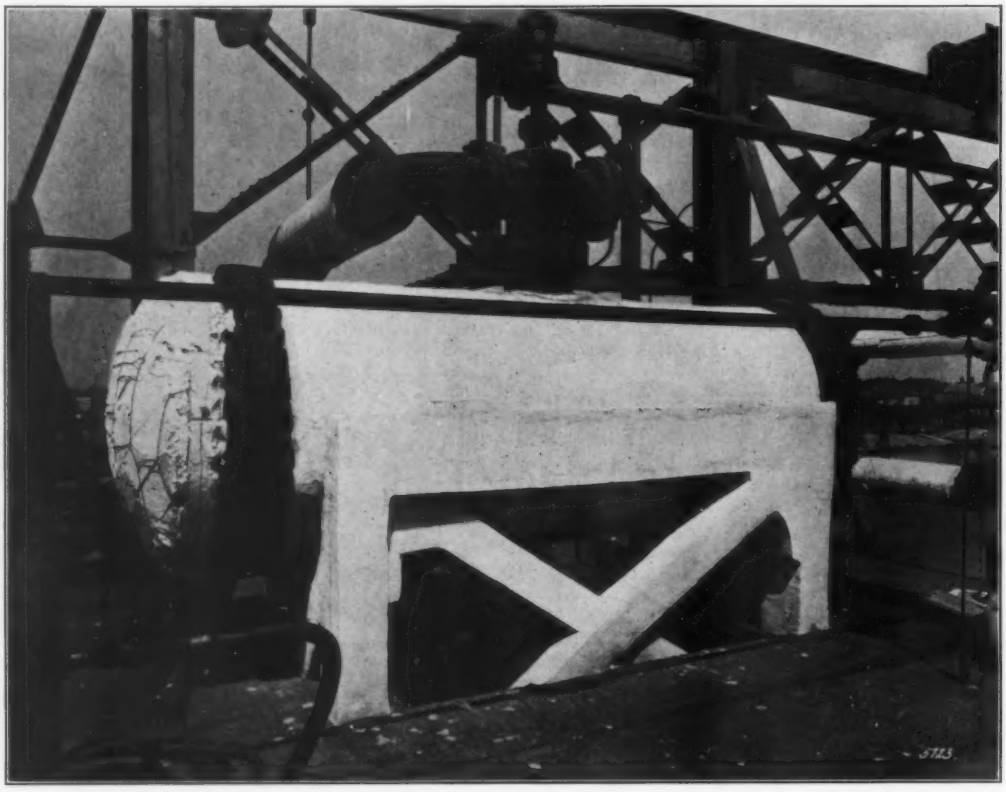
The D. T. Williams Valve Company

Cincinnati, Ohio.

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Regrinding Valves, No. 107 is one of the Williams Superior types that has built the Williams reputation for long, dependable service throughout industry. Discs and seats extra heavy, special metal, machined for a **tight bearing.** Seat may be reground with a little oil and emery; a few moments' work, and the valve is like new. No extra discs ever required, making an important saving. Stem, extra heavy and strong, of best bronze. Will not bend or break. All threads engaged when valve is closed, preventing stripping or unequal wear. **Exclusive** feature with the **Williams.** May be repacked under pressure with absolute safety. Sustains 200 lbs. pressure easily.

Install ONE and let it prove its value.



ONE OF SEVERAL ROSS PARTIAL CONDENSERS ON HIGH PRESSURE SERVICE

NOTE THE USUAL RUGGED CONSTRUCTION OF ROSS REFINERY EQUIPMENT

ROSS HEATER & MFG. COMPANY, Inc.
Buffalo, N. Y.

Representatives in all principal cities

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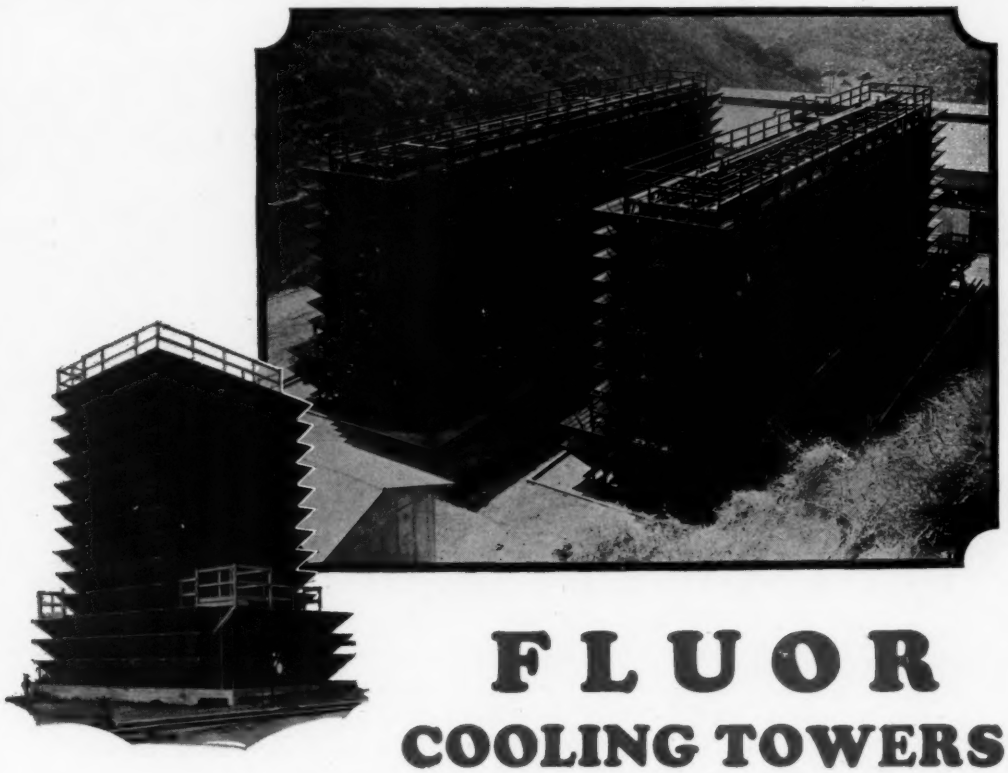

FLUOR
COOLING TOWERS
In The Compressor Station

Whether gas is to be pumped from the Panhandle to Kansas City, from Ventura to Los Angeles, or back to the oil sand, a Fluor tower is the economical answer to the cooling problem.

Fluor Redwood Cooling Towers are rapidly becoming standard equipment for large main line stations as well as for small gas lift plants.

Descriptive Catalog on Request

Jackson Engineering & Equipment Co.

909 East 59th St., Los Angeles, California

502 Nat'l Bank of Commerce Bldg., Tulsa, Okla.

FLUOR
REDWOOD
COOLING TOWERS

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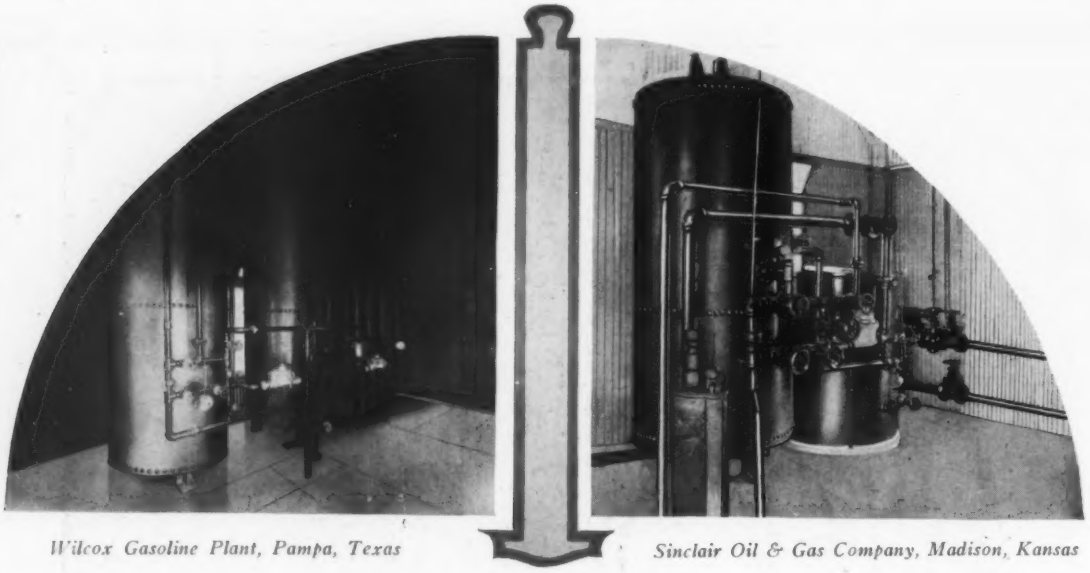

Wilcox Gasoline Plant, Pampa, Texas — *Sinclair Oil & Gas Company, Madison, Kansas*

Is Your Plant One of the Thousand?

A recent check-up indicates that some thousand natural gasoline plants are located in what are known as "hard water" regions.

These plants—every one of them—need softened water. Condensing coils will function better; engine jackets will protect engines as they are supposed to; boilers will steam more quickly and economically.

Many of these plants have been already equipped with that well known upflow zeolite softener—the Paige-Jones Softener. One company has more than thirty such units in its various plants.

The same better processing—the same lowered costs will accrue to you if the Paige-Jones softener is installed in your plant.

We'll be glad to have one of our engineers give you more definite details.

Send for the new well illustrated bulletin— "Softened Water — The Universal Need." In it there is a section of interest to gasoline producers.

Paige & Jones Chemical Co., Inc.

General Sales Office, Technical Dept. and Works, HAMMOND, INDIANA
Executive Office: 461 FOURTH AVE., NEW YORK. *Offices in Principal Cities*

Be Assured of Paige-Jones Economies

PAIGE-JONES WATER SOFTENING

ZEOLITE AND LIME SODA SOFTENERS · PRESSURE SAND FILTERS
BOILER FEED WATER TREATMENTS · HOUSEHOLD WATER SOFTENERS

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These Distributors stock ADAMANT in 100 lb., 250 lb., and 400 lb. containers. Distributors are listed under state and city, with states arranged alphabetically.

Alabama, Birmingham,
Young and Vann Supply Company
California, Los Angeles
Industrial Supply Co.
California, San Francisco,
W. E. Mushet Co.
Colorado, Denver,
H. W. Thompson
Connecticut, Hartford,
Factory Supply Company
Connecticut, New Britain,
Rackliffe Bros. Co., Inc.
Connecticut, New Haven,
The Warner-Miller Co.
Illinois, Chicago,
Wm. E. Dee Company
Indiana, Fort Wayne,
Coan Equipment Co.
Indiana, Indianapolis,
Indianapolis Belting & Supply Co.
Iowa, Des Moines,
The Walredh Supply Company
Kentucky, Louisville,
E. D. Morton & Company, Inc.
Kentucky, Paducah,
Henry A. Petter Supply Company
Louisiana, New Orleans,
Woodward Wight & Company, Ltd.
Louisiana, Shreveport,
Woodward Wight & Company, Ltd.
Maryland, Baltimore,
King's Coal and Supply Company, Inc.
Massachusetts, Boston,
Waldo Bros. and Bond Company
Massachusetts, Springfield,
Oscar F. Carlson
Massachusetts, Worcester,
Waldo Bros. and Bond Company
Michigan, Detroit,
H. D. Edwards & Co.
Minnesota, Duluth,
Duluth Builders Supply Co.
Minnesota, Minneapolis,
Northern Machinery & Supply Co.
Missouri, Kansas City,
Union Material & Supply Co.
Missouri, St. Louis,
Reed Railway Supply Co.
Nebraska, Omaha,
American Machinery & Supply Co.
New York, Buffalo,
The Curtis Supply Co., Inc.
New York, Mohawk,
The American Hard Wall Plaster Co.
New York, New York,
C. C. Phillips, 110 W. 34th St.
New York, Rochester,
American Clay & Cement Corp.
Wm. Summerhays & Son
New York, Rome,
The American Hard Wall Plaster Co
New York, Syracuse,
The Paragon Plaster Company
New York, Utica,
The American Hard Wall Plaster Co.
North Carolina, Asheville,
Southern Steel & Cement Company
Ohio, Cincinnati,
The Wm. T. Johnston Co.
Ohio, Cleveland,
The Cleveland Tool & Supply Co.
Ohio, Columbus,
The Westwater Supply Co.
Ohio, Dayton,
The Klinger-Dills Co.
Ohio, Toledo,
The Toledo Builders Supply Co.
Oklahoma, Tulsa,
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Pennsylvania, Erie,
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Pittsburgh Supply Company
Pennsylvania, Reading,
Reading Foundry and Supply Co.
Rhode Island, Providence,
B. & H. Supply Co., Inc.
South Carolina, Columbia
Columbia Supply Company
South Carolina, Spartanburg
Spartanburg Mill Supply Co.
Tennessee, Memphis,
Reed and Duecker
Texas, Beaumont,
Norvell-Wilder Hardware Company
Texas, Corpus Christi,
San Antonio Machine & Supply Co.
Texas, Dallas,
The Murray Company
Texas, El Paso,
Geo. S. Thomson Company
Texas, Houston,
Norvell-Wilder Hardware Company
Texas, San Antonio,
San Antonio Machine & Supply Co.
Texas, Waco,
San Antonio Machine & Supply Co.
Virginia, Norfolk,
Empire Machinery & Supply Corp.
Washington, Seattle,
Cragin & Co.
Washington, Spokane,
Consolidated Supply Company
West Virginia, Charleston,
South Side Foundry & Machine Works
Wisconsin, Milwaukee,
Tews Lime & Cement Co.
Wisconsin, Superior,
The Speakes Company

Canadian Distributors

British Columbia, Vancouver,
B. C. Equipment Company, Ltd.
Manitoba, Winnipeg,
Walter Belves & Company, Ltd.
Ontario, Hamilton,
Thomson-Gordon, Ltd.
Ontario, Port Arthur,
Wells & Emmerson
Ontario, Toronto,
J. H. Morrison
Quebec, Montreal,
Alex. Bremner, Ltd.

Every time a boiler comes off the line in this refinery, the brickwork is given a surface coating of ADAMANT-ADACHROME, blown on with The ADAMANT Gun, which fills up and seals all brick pores, cracks and joints, building the walls up to their original thickness and greatly prolonging lining life.

Your Linings— Keep Them in Good Condition with the ADAMANT Gun

HERE'S a way you can always be one jump ahead of your furnace deterioration and save many dollars in refractories costs.

Every time the opportunity presents, give the brickwork in your boiler furnaces and stills a surface coating of a mixture of ADAMANT-ADACHROME, blown on with The ADAMANT Gun. Fill up all the cracks, crevices, brick pores and joints.

Follow the practice consistently. Your linings will be in good condition at all times. They'll last longer and your repair costs will be materially lower, because the ADAMANT-ADACHROME Mixture is highly resistant to clinker adhesion, slags, fusible coal ash, sulphur and other impurities in either coal or oil fuel which cause slagging, fluxing or melting of brick.

Ask us to send you complete data on this money-saving way of keeping furnace linings in good condition. Write for copies of The ADAMANT Gun booklet and the ADAMANT - ADACHROME booklet.

BOTFIELD REFRACTORIES CO.
783 S. Swanson St.,
Philadelphia, Pa.

For A Long Furnace Run, Use The ADAMANT *Gun*

ADAMANT
FIRE BRICK CEMENT

Whenever you use a fire brick, use ADAMANT, *the original high temperature cement*

Mention Where You Saw the Advertisement

KELLOGG PIPE STILLS

From gasoline *to* lubricating oil

Typical of the many Kellogg pipe stills in operation and under construction, the plants referred to below indicate the wide variety of products for which Kellogg equipment is being used.

Refinery A Topped Burkburnett crude, 26-28° Be. Products — gasoline, kerosene, gas, oil, fuel oil.

Refinery B Pressure still tar, 11.7° Be. Products—gasoline, cycle stock, asphalt.

Refinery C Ohio crude, 31-32° Be. Products—gasoline, kerosene, gas oil, light wax distillate, heavy wax distillate, fuel oil.

Refinery D Reduced Colombia crude. Products—gas oil, lub distillate of 0° cold test, and asphalt stock.

Refinery E Topped Orange crude. Products—five cuts of lubricating distillate, all to be taken overhead without use of steam. Heaviest viscosity is 125 to 130, at 210° F. Operation is under a vacuum.

KELLOGG

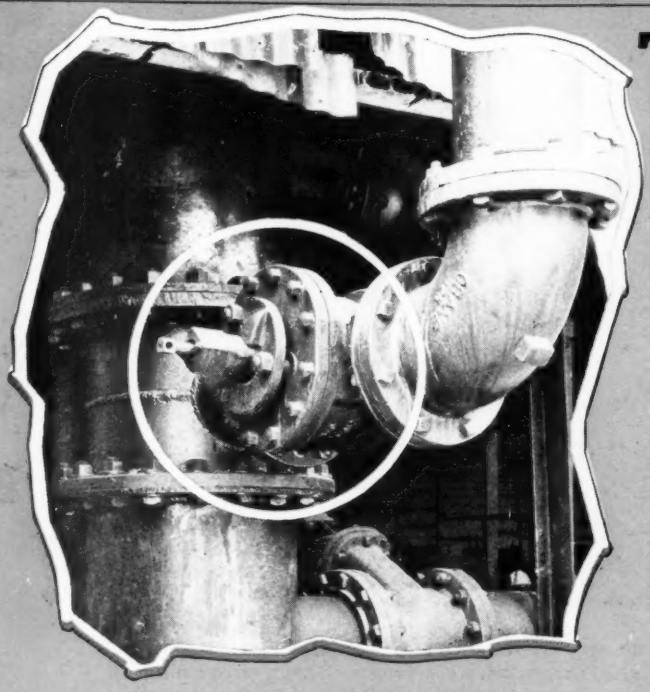
CROSS CRACKING PLANTS—BUBBLE TOWERS—PIPE STILLS—HEAT EXCHANGERS—GRAY TREATING TOWERS—TREATING PLANTS

THE M. W. KELLOGG CO., 7 DEY STREET — NEW YORK

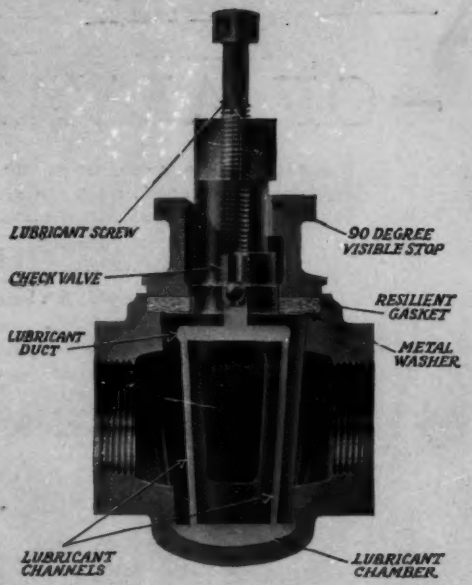
KANSAS CITY, MO., 700 BALTIMORE AVE. — SAN FRANCISCO, CAL., 444 MARKET ST.

LOS ANGELES, CAL., 329 PETROLEUM SECURITIES BLDG.

Mention Where You Saw the Advertisement

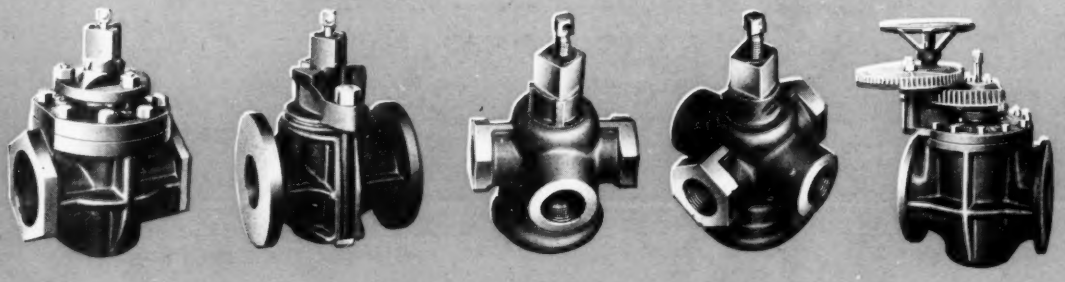


This is the valve that *enforces safety*



Merco Nordstrom Valve—*lubricated*

Always tight—yet easy to turn on or off—that's an exclusive advantage of this *lubricated* valve. You don't have to fear leaks. The lubricated plug feature keeps the valves sealed against leaks. Hydraulic pressure can be increased around the plug merely by turning the screw at top of valve. Desirable for every Refining service where valves are required. May we send catalog?



MERCO NORDSTROM VALVE CO.

SUBSIDIARY OF THE MERRILL COMPANY

Engineers—

San Francisco, 121 Second St.
Chicago, Peoples Gas Building
Cleveland, Ohio, 325 Engineers Building

Western Factory: Oakland, California

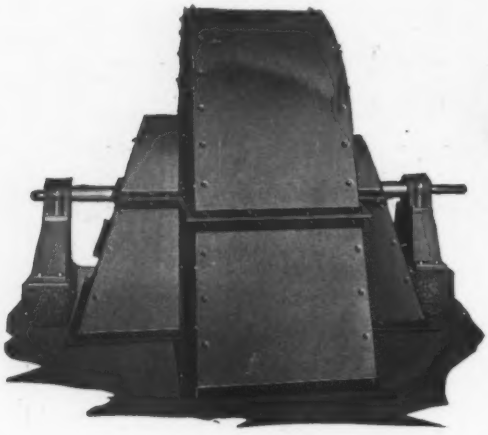
MERCO

Manufacturers

New York, 11 W. 42nd St.
Houston, 1315 Petroleum Bldg.
New Orleans, 1501 Masonic Temple Bldg.

Eastern Factory: Belleville, New Jersey

AGENCIES IN PRINCIPAL CITIES



NEW

A High Temperature Fan

—OF ADVANCED DESIGN!

Substantial improvement in the operation of the already efficient Lientz Recirculating System is accomplished through a new design of high temperature fan. The new fan effects several distinct advantages which are listed below:

EMBODYING THESE FEATURES

- All bearings outside fan housing.
- Full water cooled shaft.
- Eliminates overhanging wheel.
- Sturdily constructed of high temperature, non-corrosive metal.
- All moving parts readily accessible.
- New peaks in capacities and temperatures of gases handled.
- Minimum power cost.

WRITE FOR DETAILS

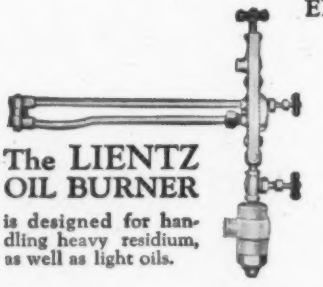
"First With the Best in Recirculation"

B. P. Lientz & Company

ENGINEERS & MANUFACTURERS

KANSAS CITY, MO.

Los Angeles New York



The LIENTZ OIL BURNER

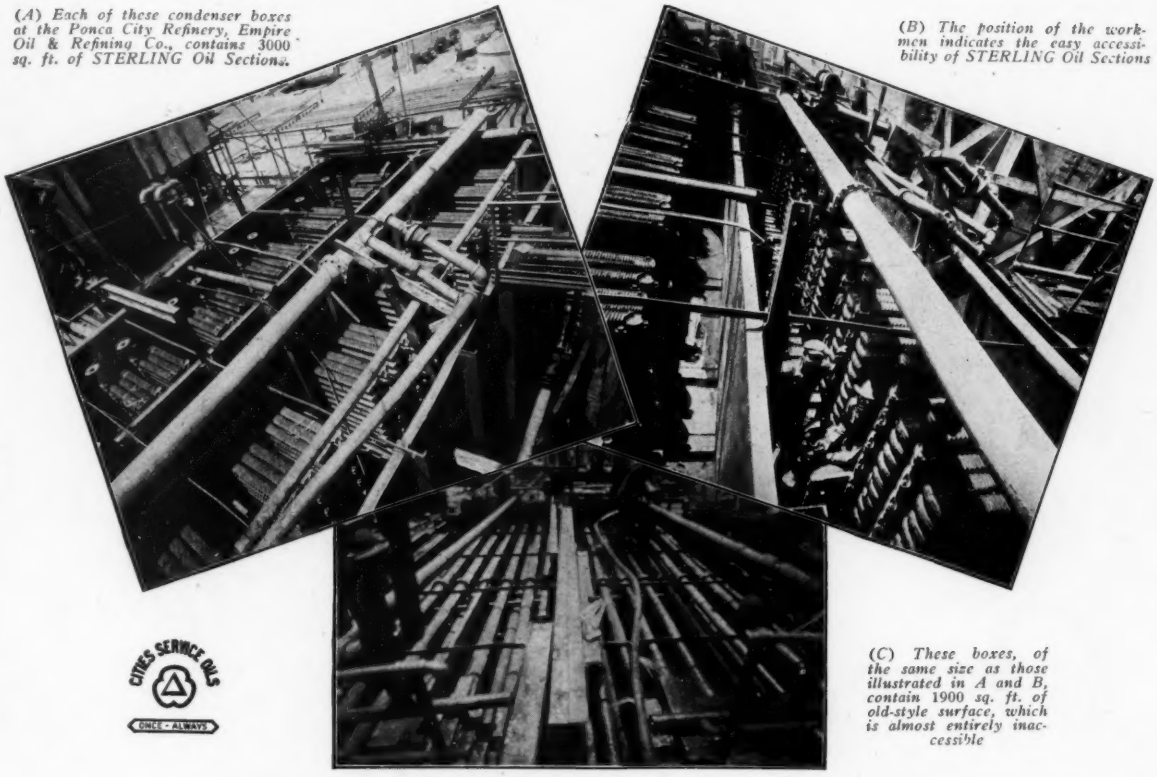
is designed for handling heavy residium, as well as light oils.

MANUFACTURERS OF
The Lientz Recirculating System,
Lientz Oil Burners,
Lientz Gas Burners,
American Oil and Gas Furnaces,
and Lientz Fuel Oil Pump Sets.

The LIENTZ RECIRCULATING SYSTEM

(A) Each of these condenser boxes at the Ponca City Refinery, Empire Oil & Refining Co., contains 3000 sq. ft. of STERLING Oil Sections.

(B) The position of the workmen indicates the easy accessibility of STERLING Oil Sections



CITIES SERVICE OILS — ONCE - ALWAYS

(C) These boxes, of the same size as those illustrated in A and B, contain 1900 sq. ft. of old-style surface, which is almost entirely inaccessible

More STERLING Oil Sections Installed by Empire Oil & Refining Company

Following a trial installation of STERLING Oil Sections at its Ponca City refinery, The Empire Oil & Refining Co., is constantly enlarging its use of "STERLINGS", not only at this plant, but also at the Okmulgee, Cushing and Gainesville (Texas) plants.

The condenser boxes at Ponca City were completely filled by 1900 sq. ft. of old-style smooth surface. Boxes of the same size now contain 3000 sq. ft. of STERLING Oil Sections—*and plenty of elbow room.*

Radiator fins which increase the rate of heat transfer over that of smooth surfaces, provide a total cooling effect considerably in excess of the rated 3000 sq. ft. of STERLING Sections.

Illustrations A and B show other exclusive features, —namely:

(*a*) The shorter horizontal flow and the quick, winding drop to the bottom of the box.

(*b*) The flat oval channels which provide the maximum of surface contact for small vapor streams flowing at high velocity.

(*c*) The greater number of manifold connections.

STERLING Condensing and Cooling Sections are cast in ARCO Corrosion Resisting Metal. The famous ground metal joint is machined to limits as close as the finest automobile cylinder work. STERLINGS cost no more (installed) than old-style surfaces.

A copy of the revised edition of our engineers book on STERLING Oil Sections will be sent free on request. Estimates, layouts, and all details will be furnished promptly by our district representatives without obligation on your part.

AMERICAN RADIATOR COMPANY

Industrial Division No. D

Factory: Springfield, Ill.

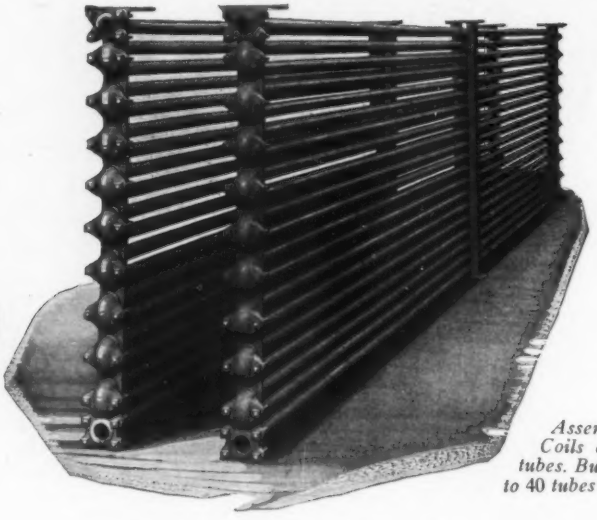
40 West 40th Street NEW YORK | 816 South Michigan Avenue CHICAGO | 935 Kennedy Bldg. TULSA | 1214 Quinby Bldg. LOS ANGELES

and now—

COOLING COILS

by

Oceco



Assembled Coils of 2" tubes. Built 20 to 40 tubes high.

An important development offering these significant advantages over pipe coils:

Tubing of whatever wall thickness and material desired.

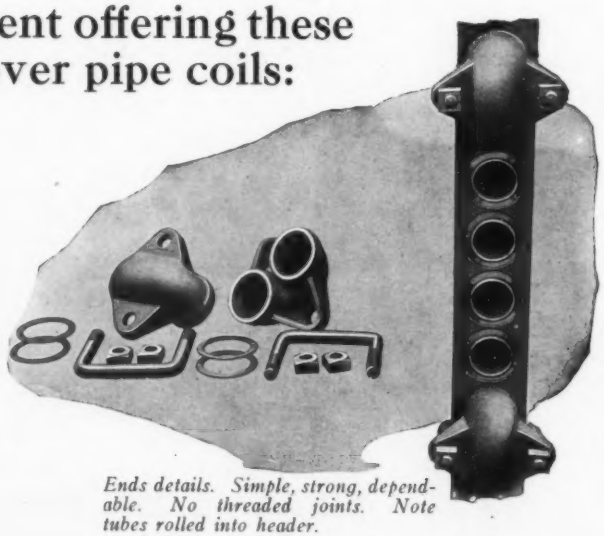
Quick and easy cleaning.

All parts readily accessible.

Less space required.

Low cost and economy in installation.

Send for the complete story with prices. It will interest and profit you.



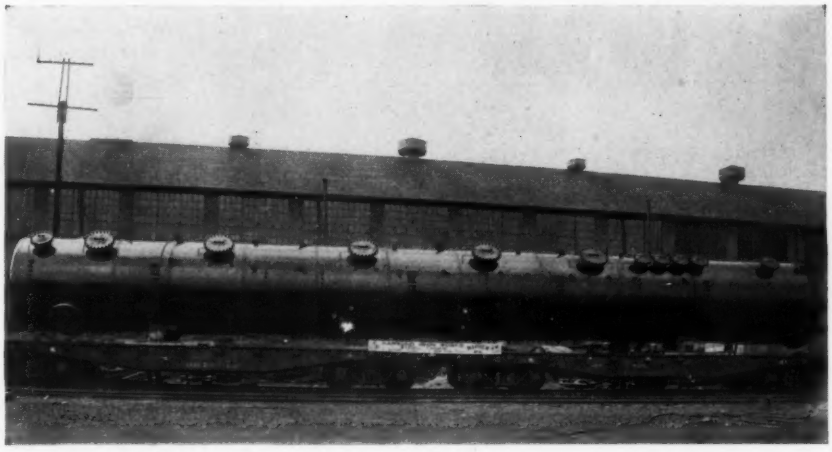
Ends details. Simple, strong, dependable. No threaded joints. Note tubes rolled into header.

THE OIL CONSERVATION ENGINEERING CO.

Headquarters for Tank Equipment

877 Addison Rd. Cleveland, Ohio

"The Sun Never Sets on HAMONDTANKS"



8 ft. 6 in. x 80 ft. Bubble Tower built for Arthur G. McKee & Co., Engineers & Contractors, one of the many products built by—

HAMMOND IRON WORKS

Our Bulletin 200—Steel Storage Tanks. 500 to 80,000 Barrels.

Our Bulletin 100—Horizontal Tanks. 1600 to 24,000 Gallons.

Our Bulletin 300—Hammond Filters.

Special Bulletin—Handling and Storing of Fuel Oil.

Material furnished Knocked Down or Erected.

HAMMOND IRON WORKS

WARREN, PA.

Manufacturers and Exporters of Steel Tanks and Steel Plate Construction

(New York Office: 17 Battery Place—Telephone 0060)

National Airoil Burners

Patented
Dec 31, 1918
Dec. 12, 1922
Apr. 15, 1924

For Power Plants and Stills and all Industrial Furnaces

NATIONAL AIROIL BURNERS
are internal atomizing burners—inside mixers —operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

NATIONAL AIROIL BURNERS
will handle the heavy residuum from cracking stills without requiring continual removal for cleaning, an immense factor in economical plant operation.

NATIONAL AIROIL BURNERS
when operating under boilers will use less than one per cent of the steam for atomizing the oil. The old style steam atomizing burners use from three to seven per cent.

NATIONAL AIROIL BURNERS
give a soft gaseous flame that does not injure brick work or boiler tubes. Made with flat or round tips.

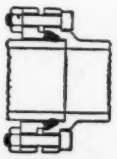
Write for our Bulletin No. 21

National Airoil Burner Company

Factory: S. W. Cor. 9th and Thompson Sts.
Sales Rooms: 1327 Girard Avenue
PHILADELPHIA, PA.

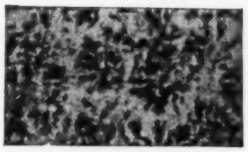
Oil Burners and Oil Burning Equipment

SIMPLEX CAST IRON CONDENSER PIPING

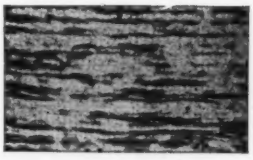


"ONE FLANGE IS LOOSE"

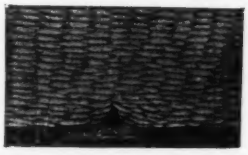
COATS ITSELF



Photomicrograph of cast iron, much enlarged, showing granular structure.



Photomicrograph of wrought iron, much enlarged, showing fibrous structure.



A piece of sheet steel, much enlarged, showing surface and sectional structure with a typical pit.

AUTHENTIC data from over 250 years of service prove that cast iron becomes coated with rust but remains practically unimpaired in weight and strength under conditions that are fatal to other kinds of metal.

Scientists believe this phenomena due to the microscopic structure of cast iron—a structure of the same granular or crystalline form as found in the iron ore from which it is made and which has laid unimpaired in the ground for untold centuries. Cast iron rusts on the surface, but the corrosive agent fails to break the natural mechanical bond between the irregular shaped granules, further oxygen is excluded by the first rust coating, and therefore corrosion stops. Cast iron literally coats itself.

In place of the interlocked grains or crystals of cast iron, wrought iron and steel are of a fibrous and, in thinly rolled steel, of a laminated structure, with distinct leaves overlapping each other. As corrosion takes place, these leaves or fibres scale off, constantly presenting a fresh surface to the corrosive agent.

Simplex pipe is flanged pipe minus the limitations of a joint made with rigid flanges. Thousands of feet of this material has been in use for years by the leading oil refineries of the United States for oil condensers.

Write for Simplex Condenser Catalog Number 55

AMERICAN CAST IRON PIPE COMPANY

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York,

Write Also for information on Our Prepared Joint Cast Iron Pipe for Oil Lines

The Holmes-Manley *Cracking* Process

Flexibility of Operation.

High Yield of Quality Gasoline direct from the Unit.

Fractionation and Condensation under Full Operating Pressure.

High Yield of Liquid Products with a minimum yield of fixed gas and carbon.

Low yield of Residue Fuel Oil of good Quality.

Relatively low Operating Temperatures.

Ease of Control.

Long Runs and High percentage of Operating Time.

Low Labor and Fuel Costs.

Address Inquiries to

THE TEXAS COMPANY

W. S. S. RODGERS

17 Battery Place, New York, N. Y.

Branch Office

816 Palace Building, Tulsa, Okla.

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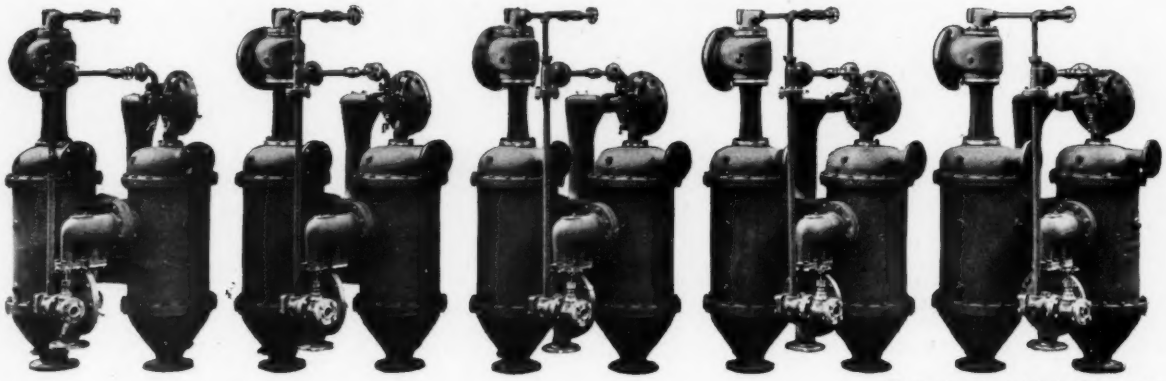


Three-stage Radojet Air Pumps for producing vacuum in high vacuum oil stills, supplied to a large oil refinery.

High Vacuum *and* Pressure Distillation Equipment

In addition to the Leach Fracto Control Condenser, we manufacture a complete line of high vacuum and heat exchange equipment for refineries and other industrial plants employing distillation in their processes.

Effective heat transfer, ranking equally in importance with high vacuum, has claimed our close attention for many years. The result is a knowledge of the factors affecting this subject that make the C. H. Wheeler line of heat exchangers both comprehensive and highly efficient.

We solicit your inquiries in regard to heat exchange and high vacuum equipment, and will be pleased to figure on the proper apparatus for any specific installation whatever its nature.

We manufacture:
Surface, Jet and Barometric Condensers; Leach Fracto Control Condensers; Oil Vapor Condensers for High Vacuum Distillation; Heat Exchangers; Sand Separators; Radojet Air Pumps for vacua up to 29.95 inches; Forced and Natural Draft Cooling Towers.

C. H. WHEELER MFG. COMPANY
19th St., Lehigh & Sedgley Aves.
Philadelphia, Pa.

C. H. WHEELER of PHILADELPHIA

Heat exchanger for a large eastern oil refinery.

Mention Where You Saw the Advertisement

Compressing "Wild Gas"

This oil-immersed motor control equipment starts a 150 H.P., 2300 volt synchronous motor driving a compressor for recovering the highly volatile gasoline which will not condense except under pressure. Gasoline that was formerly used as a fuel in the form of gas is now compressed and mixed with regular gasoline to make "high test."

This electrical equipment was selected by the engineers of this oil refinery because of the extreme fire hazard that existed. Every electrical contact from the master switch by which the motors are started, to the main contactors and field switches of the synchronous motor starter are opened and closed under oil. There can be no exposed flash of an electric arc.

Conditions under which this EC&M equipment is working are considered so dangerous that a blower is used to keep all explosive vapors out of the synchronous motor. The EC&M oil-immersed, flame-proof motor starting equipment is safe without such precautions being taken.

Write us for literature on EC&M flame-proof starting equipment

Oil-Immersed Master Switch

Oil-Immersed Field Relay and Contactor

Oil-Immersed Synchronous Motor Controller

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK - 50 CHURCH ST.
CHICAGO - CONWAY BLDG.
DETROIT - DIME BANK BLDG.
BIRMINGHAM - BROWN-MARX BLDG.
CINCINNATI - FIFTH NATIONAL BANK BLDG.
LOS ANGELES - 912 E. THIRD ST.
SALT LAKE CITY - 228 SO. W. TEMPLE
TORONTO - REFORD BLDG.
PHILADELPHIA - WITHERSPOON BLDG.
PITTSBURGH - OLIVER BLDG.
SAN FRANCISCO - CALL BUILDING
MONTREAL - DRUMMOND BLDG.
TULSA - 217 E. ARCHER ST.

Mention Where You Saw the Advertisement

A MODERN FABRICATING PLANT, MAINTAINING LARGE STOCKS OF STEEL, MANNED BY SKILLED WORKMEN,

LOCATED NEAR THE OIL FIELDS WITH THREE DIRECT RAILROADS AVAILABLE FOR SHIPPING

MAKES **UNITED**

THE IDEAL SOURCE FOR SATISFACTORILY MANUFACTURED AND PROMPTLY SHIPPED

OIL REFINING EQUIPMENT

OVER 25 YEARS OF SPECIALIZATION INSURES COMPLETE SATISFACTION.

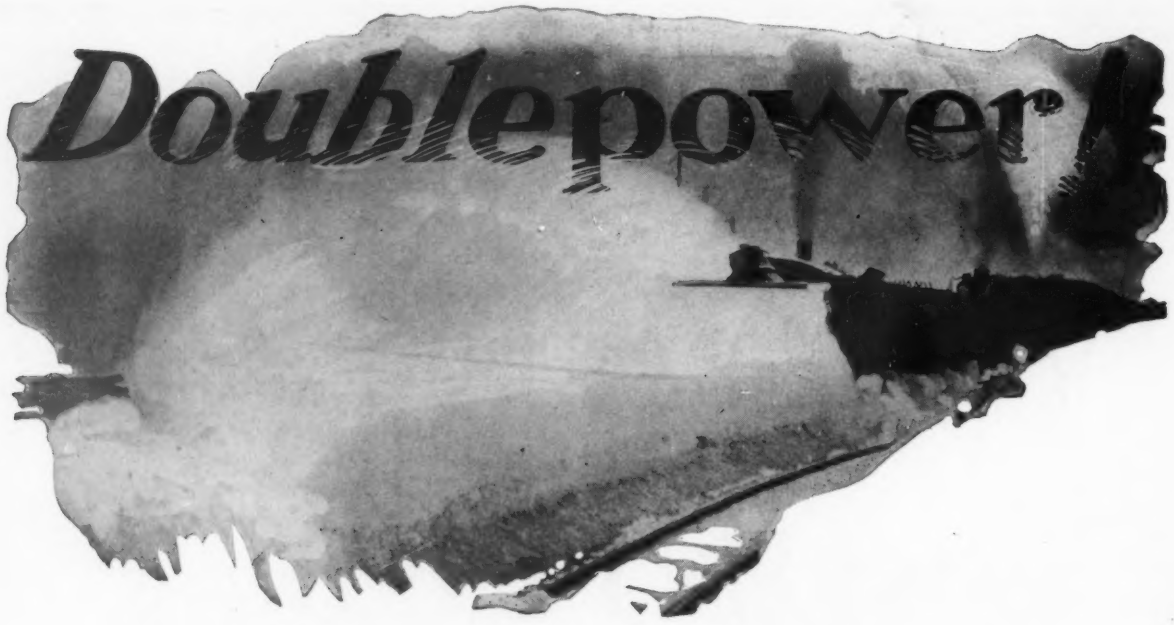
WIRE—WRITE—PHONE

UNITED
IRON WORKS, Inc.
KANSAS CITY, MO.
GENERAL OFFICE

Sales Office
TULSA, OKLA.
114 N. Rosedale

"UNITED" IRON WORKS INC. STYLE FOR SERVICE

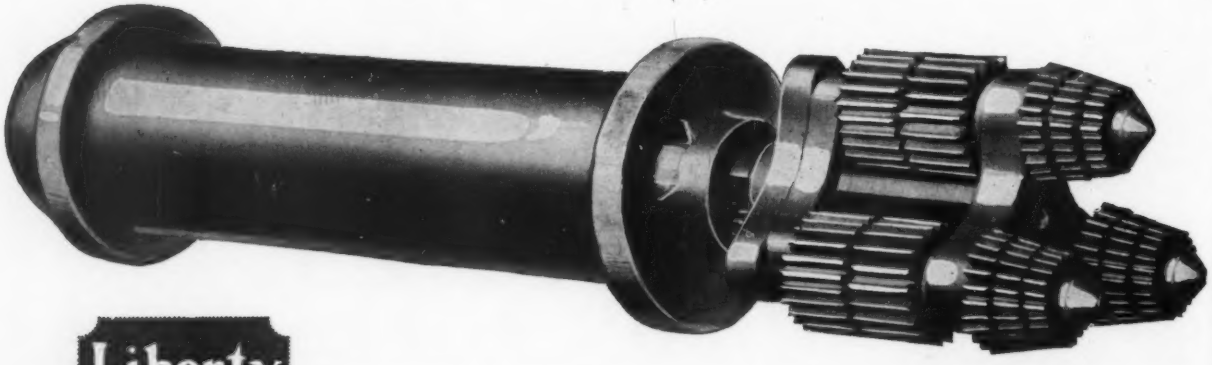
Sales Office
DALLAS, TEXAS
Magnolia Bldg.



IT takes *two* engines behind the rotary plow to buck the big drifts. That is why we designed the TANDEMTYPE LIBERTY CLEANER, with *two* cylinders behind its husky cutterhead. The heaviest deposit of tough scale cannot stall it.

With *twice* the power of the ordinary cleaner the TANDEMTYPE LIBERTY makes new speed records in the hardest cleaning job, and cuts time almost in half on any job, light or heavy.

Give short shift to Scale, with the LIBERTY TANDEMTYPE CLEANER. Bulletin Z-2 tells its story.



Liberty Cleaners

Z-1051

Liberty Manufacturing Co.
Jeannette, Pa.

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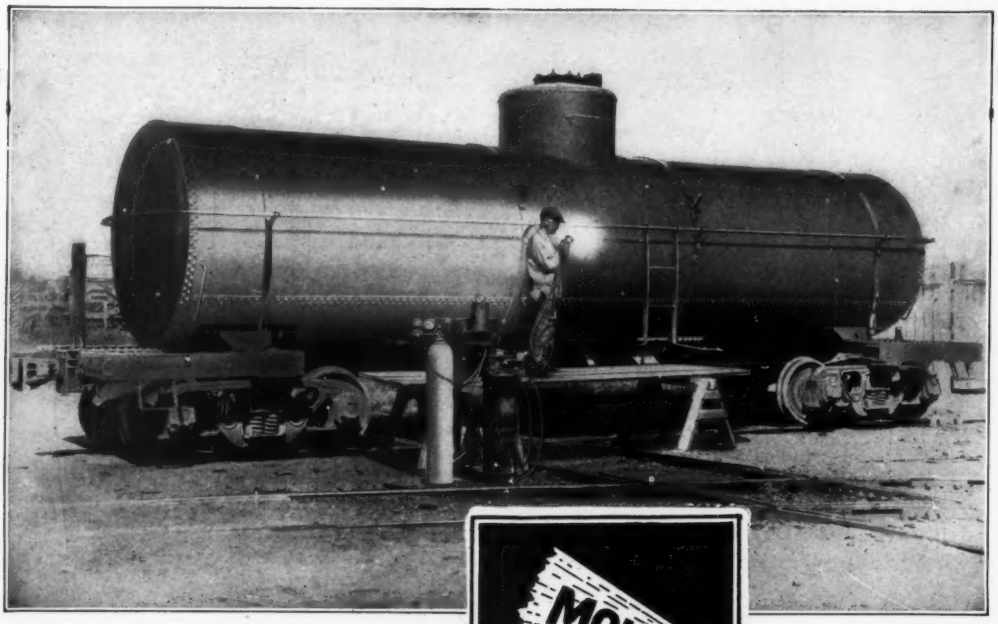
ZINCŌTING METALAYER

for "Everlasting Protection" from Corrosion



ZINCŌTING is the word which designates the application of pure zinc sprayed in molten form, on any surface, by METALAYER only.

ZINCŌTING offers "Everlasting Protection" to all iron or steel equipment subjected to atmospheric corrosion. An Oil Tank, a Gas Holder, a Steel Tower, a Bridge, a Fire Plug, a Street Lighting Standard, a Ship Fitting, if of iron or steel, it comes within the purpose and scope of our process.

METALAYER is the "Tool Versatile", and the only way for YOU to appreciate its many time and money saving uses, is to:

Come to Philadelphia and see it in action on your particular class of work.

Remember ZINCŌTING is "only one" of the numerous functions of METALAYER. Briefly, METALAYER will apply (impact) any commercial metal, in sprayed molten form, on ANY SURFACE,—whether it be metal, wood, plaster, glass, cloth, paper, concrete, etc.

If you can't come to see METALAYER in action, send for our new CATALOG.

Send for the MetaLayeR Book

METALS COATING CO. of AMERICA

495-497 N. 3rd St., Philadelphia

Chicago **London** **Prague** **Berlin** **Hamburg**

Absolutely prevent *deterioration inside* **cracking drums** by use of Holzapfels Heat Proof Protective

Efficient Protection against **Hydrogen Sulphide** on under side of tank tops by Rubshell priming with Rubshell No. 5.

Sole Makers

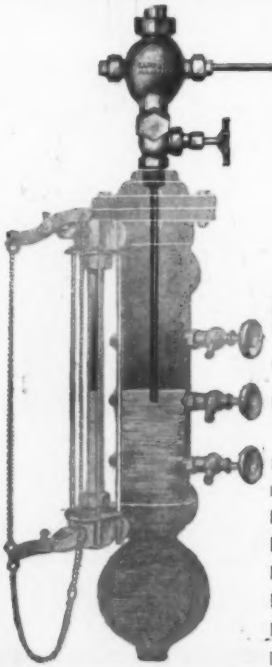
International Compositions Company

25 Broadway, New York

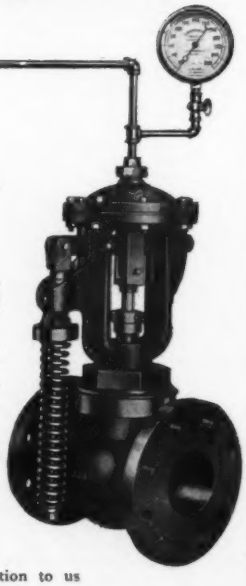
Texas Agents: J. A. ROSSITER Co., Union National Bank Bldg., Houston

Four Big Refineries are using 56 Campbell Boiler Feed Water Regulators

(Protected by patent application)



Entirely new principle.
No moving parts.
No floats, no links, no thermostats, no generators. Nothing to get out of order.
Ideal for oil refinery and field boilers.



Put them on your most troublesome boilers. Place the control valves anywhere. The connecting pipe may be any length, any shape or size, crooked or straight. The only requirement is that it must be able to transmit pressure from one end to the other.

You can depend upon the Campbell at all times and under all circumstances.

Any mechanic can install it. In fact it is the easiest feed water regulator in the world to install, and it COSTS LESS to install it.

Complete details and prices on request.

Check items below, write your name and address on the margin of this page, and mail to us.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

275 South St.,
Newark, N. J.

Please send information concerning the following without any obligation to us whatsoever:

( ) Feed Water Regulators
( ) Reducing Valves
( ) Damper Regulators
( ) Temperature Regulators.
( ) Float Valves
( ) Swing Joint Fittings
( ) Thermostats
( ) Balanced Valves
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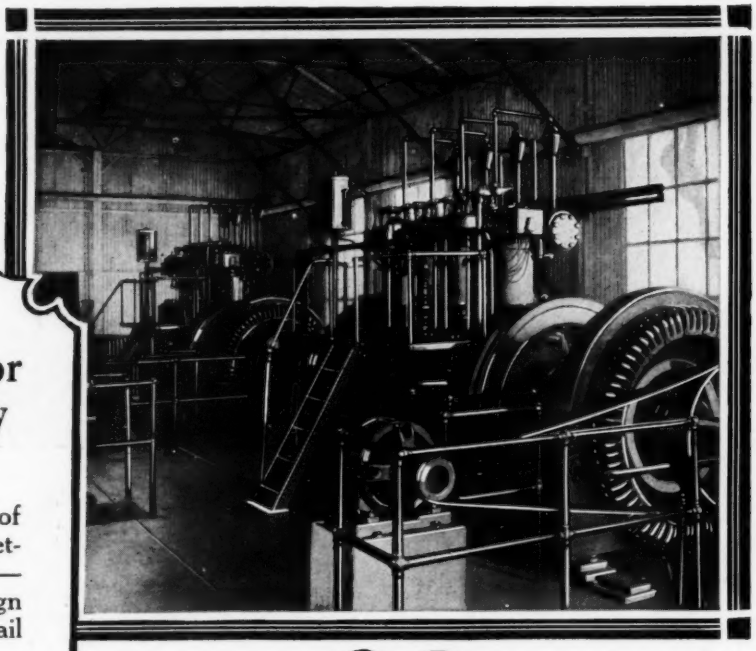

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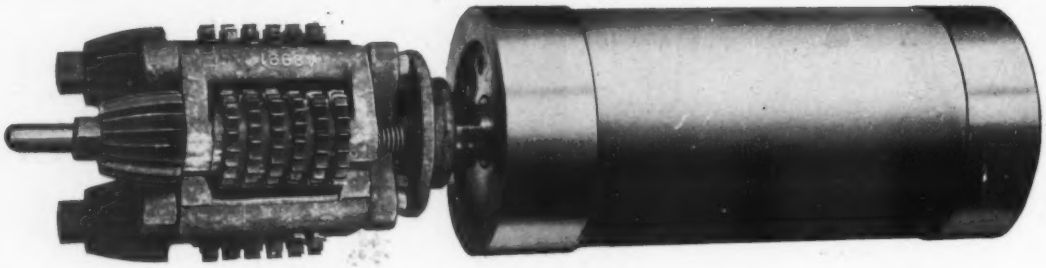

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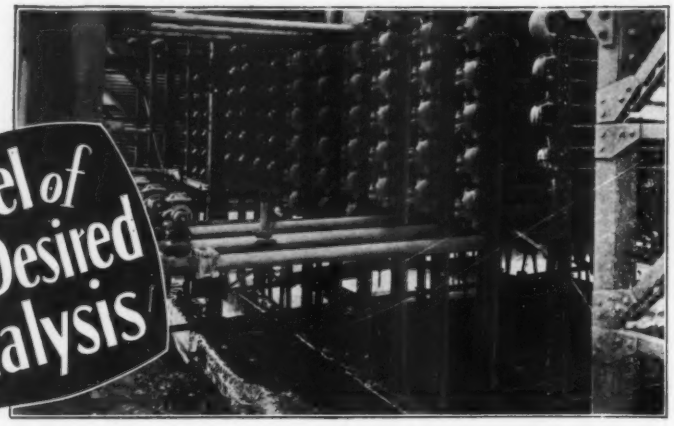

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Vol. 6, No. 12

DECEMBER, 1927

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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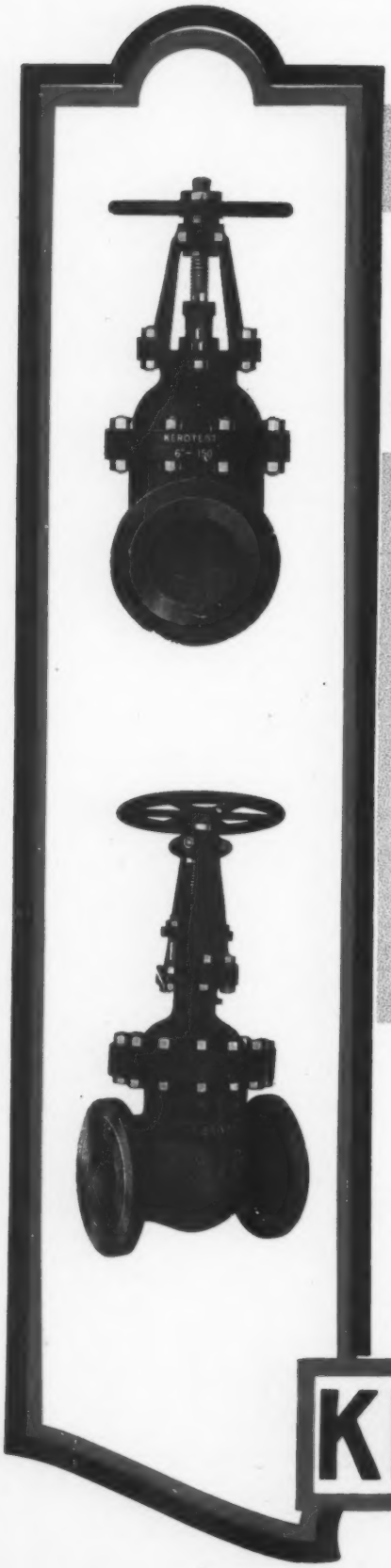

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WITH the rise of crude oil production in West Texas, the sulphur problem looms larger before the refinery chemical engineer. His major task for the next two or three years seems to be wrapped in this crude oil.

It is not fair to this promising oil producing territory to place the stigma of sulphur on it. Sulphur bearing crude oils are not new. When oil production moved west from Pennsylvania, no doubt there was a shaking of heads over what would happen to pipe line and refining equipment, due to the sulphur content of western oils.

The West Texas production but augments an old problem. It is certain that the petroleum industry has never before faced such an amount of sulphur bearing oil as is indicated from West Texas. While the amount of the oil is stupendous, the ratio of sulphur content is high in some of the oils and present in most.

Statisticians believe there will be at least 200,000 barrels of this oil available for daily refinery use in 1928. It will supplant either immediately or at some remote date that much oil of a lower sulphur content. Therein is the problem of the chemical engineer.

Shortly the refining plants of the world must accept 200,000 barrels of oil of high sulphur content. The time is not far away when a half million barrels of this oil will be ready for refinery consumption.

Unless the life of refinery equipment is shortened, the chemist must find methods of treating this oil to counteract the corrosive action of sulphur compounds. Action of these compounds can be counteracted, but the cost of most of the methods now known is excessive, comparing with the cost of the speedy deterioration of equipment.

While the amount of West Texas crude available for refinery use is limited, the sulphur problem is being solved to some extent at least by mixing it with oils of lower sulphur content. This is being done by some of the transporting companies. This is little more than a means of postponing real solution.

The amount of West Texas crude is so great, if potential figures are a true criterion, that the day must come when mixing this oil with other crudes will not be feasible. It will be necessary for refining plants to accept West Texas crude as it is.

Then the chemist must afford some relief, or the deterioration of equipment will become more serious.

Whatever the solution, it will mean increased cost of plant operation.

Grady Tijbert

The illustration shows Getty Gasoline Company's new gasoline plant, containing four Cooper Type-80 single gas engines in the Long Beach, California, field.

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California Association Digs Deep Into Natural Gasoline

Fall meeting in Los Angeles brings several important contributions to scientific trends

By BRAD MILLS

THE fall meeting of the California Natural Gasoline Association, which was held at Los Angeles, November 15 and 16, left no doubt in the minds of the members that the possibilities of the natural gasoline industry in California are almost unlimited.

Attendance was unusually high, more than 400 members and visitors having registered for the meeting. Practically the entire membership attended, while visitors included men prominent in the natural gasoline industry all over the United States. George Granger Brown, professor of chemical engineering at the University of Michigan, and director of research for the Natural Gasoline Association of America, addressed the association on "The Value of Natural Gasoline as a Constituent of Motor Fuel." A. V. Bourque, secretary of the Natural Gasoline Association of America, with headquarters at Tulsa, attended the meeting as the representative of the national association.

George L. Ratcliffe, president of the association, presided at the meeting and delivered an address Tuesday morning. He outlined the purposes of the association, saying that it was organized to help the men of the industry in every possible way. He stated that California is suffering from a slight overproduction of natural gasoline, but conditions in there were far better than in many parts of the country. California is now producing about 1,415,000 gallons of natural gasoline daily, he said, while approximately 1,365,000 gallons are being utilized. The State's storage at the present time is 33,000,000 gallons, Mr. Ratcliffe said. The big problem is to find additional outlets for the surplus, he concluded.

The banquet given at the close of the meeting was attended by more than 500 members and guests. An elaborate entertainment program followed the dinner. LeRoy Dawson was toastmaster and John Wiley itnroduced the entertainers—some in a rather intimate manner. A. V. Bourque, Dr. Brown, Norval White, Pacific Coast representative of the American Petroleum Institute, and several others made two-minute talks.

A paper on "Proposed Tentative Standard Pressure Charcoal Test for Gasoline Content of Natural Gas," prepared by the testing committee of the association and being a summary of its recommendations, was presented by P. S. Magruder, General Petroleum Corporation, sub-chairman of the committee. The discussion was led by W. W. Robinson, Jr., California Gasoline Company.

The subject was presented as an effort to develop a standard procedure to be used in determining gasoline content of natural gas by the 30-pound charcoal method. Recommendations consists of apparatus to be used in this work to the extent of cooling area of condensing system, accuracy to which volume and quantity are to be read or calculated, and the two principal controlling factors of the yield obtained, namely: the rate at which the gas shall be passed through the charcoal, and the point at which the test shall be terminated. Recommendations covering these two points are as follows:

Gas containing gasoline to extent of one gallon to 1000 cubic feet, the rate shall be 15 cubic feet per hour.

From one gallon to three gallons, 10 cubic feet per hour.

From three gallons and above, six cubic feet per hour.

The test shall be terminated at the top of the fourth temperature rise.

Specifications

A paper entitled "Quality Survey of California Natural Gasoline," prepared by the specifications committee of the California Natural Gasoline Association, was presented by R. W. Garman, Union Oil Company of California, chairman of the specifications committee. The discussion was led by D. M. Wolfe, Standard Gasoline Company.

This report gave a brief statistical report on California natural gasoline on the basis of Engler curves. This was offered to inform those interested in natural gasoline what sort of gasoline is available, and furthermore, where quality improvements without too great quantity sacrifice may be possible in the future. One specific recommendation was made—all samples for Engler distillation should be taken at the tank pressure existing at point of sale by means of two connections to the tank, and should be carefully refrigerated to 34 degrees F. before transfer to the Engler flask. It was also suggested that when refiners wish to limit the Engler curve at a midpoint, they use a 60 per cent reading on reverse-plotted curves. Finally, the results of experimental work in obtaining true vapor pressure of natural gasoline at sales delivery point will be awaited with interest, the outcome to determine further work of this committee. It may be possible at some later date to recommend that vapor pressure and gravity be the only governing factors necessary; other qualifications, such as color, corrosion test, doctor test, and end point, to hold in all cases. A distillation test more adaptable to natural gasoline may also be developed.

Measurement

"Recommendation for Standardization of Barometric Pressure of Natural Gas Measurement," prepared in conjunction with the metering committee of the association, was read by Ben Laulhere of the Southern California Gas Company. Discussion was led by Fred S. Champion of the Southern Counties Gas Company

The Pacific Coast Gas Association recently adopted a pressure standard of 14.733 pounds for use in establishing the unit of measurement. This conforms to the accepted standard for gas testing work and the measurement of manufactured gas. There seems to be no good reason why this should not be adopted for natural gas measurement.

The barometric pressure enters into the measurement of gas only in that it is necessary to know it to arrive at the absolute pressure of the flowing gas.

Several methods of making the necessary corrections due to the use of present extension tables were suggested:

1. Use of multipliers.
2. Adjustment to gauge.
3. Use of a slide rule instead of tables.

It was suggested that changes for barometric pressure corrections be made for every 200 feet change in elevation.

Vapor Tension

C. W. Gard of Union Oil Company of California presented a paper on "The Determination of Vapor-Tension of Volatile Liquids," a comparison of the method proposed by C. P. Beistle, United States Bureau of Explosives, with present Bureau of Explosives Standard Vapor-Tension Test for Gasoline. Discussion was led by F. S. Burt, General Petroleum Corporation.

The method of Vapor Pressure Determination discussed in this paper dealt with that method proposed by C. P. Beistle, which has been generally accepted as giving true vapor pressure indications on Natural Gasolines tested, however in carrying out the test as outlined by Mr. Beistle it was discovered that errors of considerable importance existed and it was necessary to make a number of changes in the equipment in order to more

closely approach the true vapor pressure of natural gasoline.

It was further pointed out that the proposed method would give a true vapor pressure on a pure liquid. Some obvious reasons were pointed out why the method will not give a true vapor pressure determination of complex liquids such as natural gasoline.

Data was given in the paper showing the wide variation experienced in making determinations for vapor pressures of natural gasoline, using the old Bureau of Explosives bomb which has been in common use for several years, and the proposed method of Mr. Beistle.

Fractionation

A paper on "Analytical Gas and Gasoline Fractionation at Low Temperatures" was presented by Lester O. Warner, of Barton, Manning & Warner, consulting engineers. Discussion was led by E. D. Cumming, of the Shell Company of California.

The petroleum conservation program applied to natural gasoline production has required increased testing efficiency. Operations previously relied upon empirical methods which do not give information about the composition.

The object of low temperature fractionation is to separate the gas or gasoline into the actual chemical compounds and measure them in a pure state. This is done by a series of distillation at temperatures produced by using liquid air. The apparatus is of glass and the separation is made under high vacuum. Accuracy of very high order is attained and can be sacrificed for rapid analysis. Applications include standardizing other empirical tests and control of exacting processes. Its greatest value lies in determining efficiency of extraction equipment and development of new petroleum products and equipment for its manufacture.

George F. Pressing, chairman of the Petroleum Section of the National Safety Council, presented a paper on "Safety and Fire Prevention in Gasoline Plants."

Mr. Pressing pointed out that safety in any branch of the oil industry starts with the study of experience, goes through a phase of an engineering revision and ends in the education of personnel in safe practices.

It was shown that the usual report of accidents is inadequate to get the bottom of the causes. A thorough investigation usually shows why accidents happen and makes the way clear for preventing similar accidents.

It is necessary to appeal to the men to prevent accidents in words they understand, and to create an unselfish interest, it was shown.

A review of accident records shows that about 20 per cent of the accidents are due to mechanical failures, while the remaining 80 per cent are human in their ultimate causes, it was stated. It was further shown that when a man fails, the unguarded machine takes its toll.

Mr. Pressing showed that the majority of gasoline plant and refinery fires were preventable. The failure of valves and subsequent neglect to test for gas before applying torches has been the cause of many preventable accidents, he said.

The value of fighting imaginary fires was shown. An example was given, showing an imaginary emergency was met. In one specific problem a gasket on top of one of the absorbers blew out and an explosion followed, with the entire absorption plant in flames. It was assumed that the plant operator was burned. The fireman blew the whistle and met the compressor plant man at the fire-house. The man was given first aid as if he really had been injured, the gas was shut off and all details were attended to as if the fire had been real.

Vapor Conservation

The paper entitled "Production of Natural Gasoline by the Conservation of Vapors" was presented by W. G. Palmer. The author's purpose is to suggest the best means for conserving petroleum vapors in field operations; refinery vapors are mentioned but not discussed in detail. He classifies the vapors as coming from storage tanks, lease or rundawn tanks, dehydrators, and reservoirs.

Results are given of tests made to determine the effect of color of the tank shell on shrinkage of vapor contents, and of tests to determine other factors in vapor conservation. The ideal conditions under which tank vapors can be handled are discussed and these conditions are stated to include:

(a) Vapor tight tanks, and (b) adequate relief valves and other control equipment. Reference is made to two forms of tank vapor control valves; the direct-acting and the indirect-acting.

Vapor-gathering systems are stated to consist of (a) tank laterals and (b) main lines. The following factors are named as important in tank-lateral operations: (a) correct breather valves; (b) correct size of vapor line from tank to control valve; (c) provision for trapping pipe scale; (d) proper pitch of vapor line; (e) adequate drainage; (f) control line; (g) location of control valve.

The second day was devoted to an address by George Granger Brown, Professor of Chemical Engineering at the University of Michigan, and Director of Research for the National Gasoline Association of America.

Motor Performance

During the morning session Dr. Brown discussed the volatility characteristics of gasoline motor fuels and the relationship of these volatility characteristics to motor performance. In this discussion he particularly stressed the necessity of segregating motor fuel volatility characteristics into three distinct "effective" phases, namely, the effective phase below the 10 per cent on the Engler distillation curve, the effective phase between the 10 per cent and the 50 per cent points, and the effective phase of the heaviest components as defined by the 90 per cent point.

As outlined by Dr. Brown, the effective volatility indicated by the initial 10 per cent range on the Engler distillation curve determines the relative ease of starting a cold motor, where ease of starting is defined as the ease of obtaining the first explosion.

After the motor has been "started," however, that is after the first few explosions have been obtained, then the fuel must exhibit certain additional accelerating characteristics in order to permit of picking up a load with a cold motor without having to resort to the excessive use of the choke. The accelerating characteristics of a fuel are indicated by the 10-50 per cent range of the Engler distillation curve.

With a motor once under proper headway and thoroughly heated up, we then find the third volatility characteristic of a fuel coming into prominent consideration. This third volatility phase revolves around the 90 per cent point of the Engler distillation curve and determines the degree of efficiency with which the motor will operate under conditions of part open throttle.

In the afternoon session, Dr. Brown discussed the anti-knock characteristics of various motor fuels and the so-called gas lock effect sometimes experienced when using fuels having excessively low initial volatilities.

In discussing the anti-knock properties of various fuels, Dr. Brown stressed the point that compression ratios much over 6:1 do not appear practical for the ordinary automobile engine driven and serviced by the ordinary run of driver and garage mechanic; and furthermore, that with such a 6:1 compression ratio we should be able to obtain thoroughly satisfactory service from fuels composed of blends of natural and refined gasolines without resorting to a further blending of special anti-knock compounds with these gasolines.

The so-called gas locking of the carburetor was shown to be caused by the heating of the fuel in the carburetor to a temperature such that premature vaporization occurs within the passages of the carburetor leading to the atomizing jets, or within the jets themselves. This premature vaporizing of the gasoline, of course, holds back the flow of fuel into the manifold and causes the engine either to lose power or to fail to run altogether. The cure for such gas locking resides in the elimination of excessively low initial volatilities.

The high point and almost startling factor brought out by Dr. Brown's address was that considerably heavier fractions can be advantageously used in gasoline motor fuels than is now the practice, providing sufficient additional natural gasoline is added to the fuel to give correct initial and 10-50 per cent effective volatilities. Such a change in the motor fuel compostion as advocated by Dr. Brown would result in turn in a material increase in the percentage production of straight run gasoline cut from each barrel of crude run through the refinery and, furthermore, according to Dr. Brown, such a gasoline would be a material improvement over the average commercial product now marketed.

Determination of Vapor Tension Of Volatile Liquids*

By C. D. GARD
Union Oil Company

THE subject of vapor pressure of natural gasoline is one of which has been given a great deal of study by many men engaged in the making and marketing of natural gasoline. The present practice of using the so-called Standard Vapor Pressure Bomb has not been very satisfactory, and anyone who has made vapor pressur determinations with it knows that the results were neither consistent nor accurate. Several attempts have been made to design a bomb which would give a more accurate method for vapor pressure determination.

The method herein discussed deals with that proposed by C. P. Beistle of the United States Bureau of Explosives. The fundamental principle involved is one in which the vapor pressure of the liquid in the presence of the entrapped air is measured. This measurement is accomplished by taking one pressure reading on the mixture, doubling the volume by withdrawing liquid, allowing the pressure to become constant and holding the temperature constant, then taking the second pressure reading. The vapor pressure of the mixture is then computed from the two pressure readings. In this manner the vapor pressure of any foreign vapor or gas, such as air, is cancelled out of the calculation and the result gives the vapor pressure of the liquid in the bomb.

It all looks very simple and logical enough and a sufficient number of tests were performed by the proponent of this method to indicate that reliable results could be obtained.

However, before going into the actual performance of the method let us review the principles involved and the results which we are trying to get. First, we will consider a true liquid, this definition applying to such substances as water, alcohol, ether, carbon bisulphide, acetone, etc. If we should take any one of these pure liquids and pour it into a closed vessel, leaving a vapor space above the liquid, then the total pressure on the walls of this vessel would be the pressure of the air plus the pressure of the vapor, each constituent present acting as though the other constituents were not present. Now if we withdraw a portion of the liquid from the container until we have doubled the vapor volume above the liquid and we do not vent any of the vapor, the volume of air in the container remains the same as originally, but it is in a space twice as great. Therefore the pressure exerted by the air is one-half the first pressure. However, since the temperature of the container has been held constant the vapor from the liquid will exert the same pressure as originally.

*Before fall meeting of the California Natural Gasoline Association, Los Angeles, November 15 and 16, 1927.

Pressure Calculations

The pressure of the vapor of the liquid may then be calculated as follows:

Let X = pressure exerted by air at first reading.

P = pressure exerted by vapor at first reading.

Then total pressure at first reading $A = P + X$

At the second reading,

$\frac{X}{2}$ = pressure exerted by air

P = pressure exerted by vapor

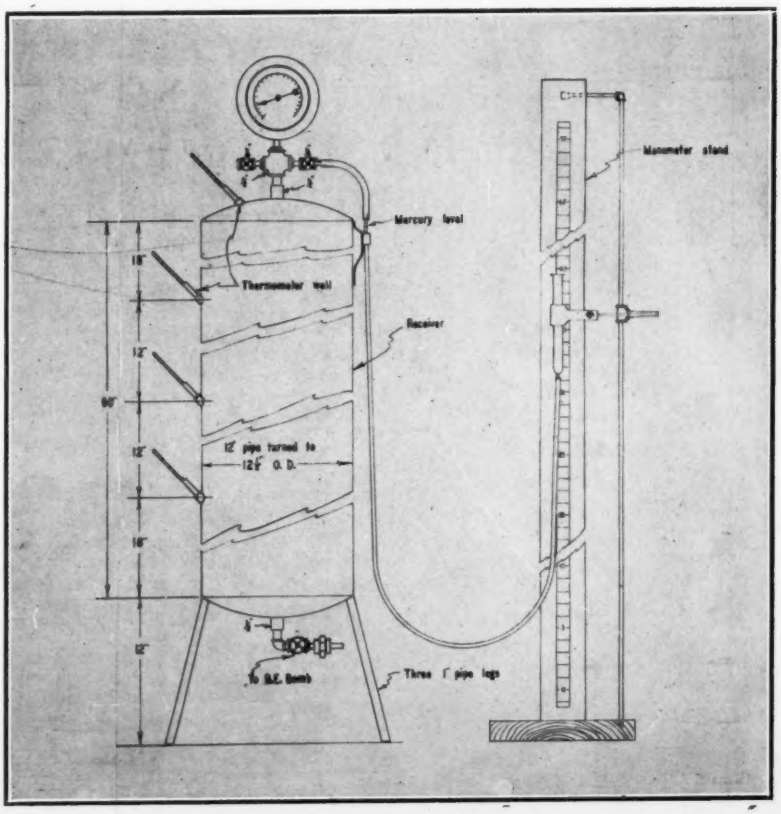
Then total pressure at second reading

$$B = \frac{X}{2} + P$$

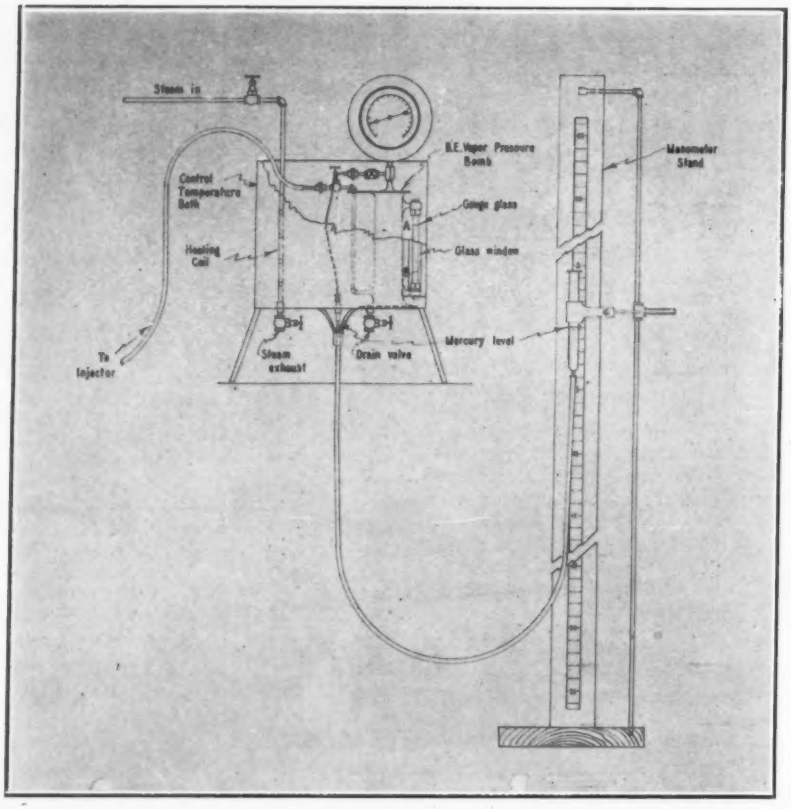
Therefore $P = 2B - A$

Now let us further consider just what happened when we withdrew liquid from the container. First, we lowered the pressure on the liquid because we increased the vapor space above the liquid. The result of this lowering of pressure was a vaporization of the liquid, this vaporization continuing until the pressure exerted by the vapor is that pressure corresponding to the temperature at which the contents are held. At all times the vapor which came from the liquid is exactly of the same material as the liquid. Next, the pressure exerted on the walls of the vessel is the sum of the pressures of the vapor constituents. If we could separate this vapor from the liquid and hold it at the same volume and temperature we would find that it would still exert the same pressure as when in the presence of the liquid.

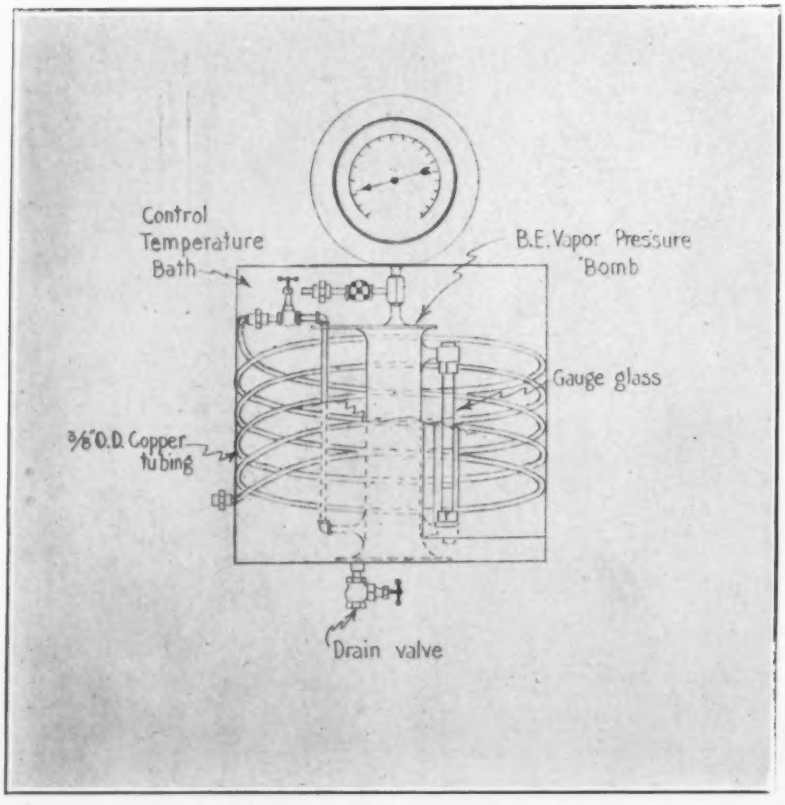
A vapor pressure test run on a pure liquid checked very closely the known vapor pressure of the liquid. This test further substantiated the cleams of accuracy for the method used, hence it was decided to run some vapor pressure tests



GASOLINE PRESSURE RECEIVER



ASSEMBLY OF VAPOR PRESSURE APPARATUS USING NEW B. E. BOMB



ICED SAMPLING DEVICE FOR VAPOR PRESSURE BOMB

on gasoline. The first difficulty we found was that the sample to be tested had to be weathered to atmospheric pressure if we were to pour it into the bomb as specified. To overcome this and in order to get the actual vapor pressure of gasoline stored under pressure, the apparatus was changed to include a valve immediately below the gauge so that the bomb could be filled under pressure. Tests were then conducted and much to our surprise we found that the indicated vapor pressure was much below the pressure on the storage tank. As there were several possible errors in assuming that the storage pressure of gasoline was the true vapor pressure of the gasoline at the storage temperature, a large container was built and filled completely with gasoline under the storage pressure. A small amount of gasoline was then withdrawn from the large container to form a vapor space above the liquid. In this way we were convinced we could obtain the true vapor pressure of the liquid. The tests were continued and it was found that the vapor pressures as indicated by samples drawn from the bottom of the container were still lower than that pressure indicated by the gauge on the container but the difference was less. It was then noted that there was considerable wire drawing of the gasoline through the valves on the bomb and that perhaps light vapors were being vented from the top valve on the bomb. To eliminate this error the samples were then drawn through a coil placed in an ice-salt bath, the bomb was purged with gasoline and completely drained before filling for the test. No vapors were vented from the top. By keeping the bomb also submerged in the ice-salt bath it was found that the bomb could be completely filled with gasoline. The vapors which remained in the bomb after purging condensed at the lower temperatures and at the same time those vapors liberated from the gasoline in drawing the sample were also recondensed. When the vapor pressure test was conducted it was found that the pressure checked very closely with the pressure on the large container. The gasoline tested had a vapor pressure of about 10 pounds gauge at 70 degrees F.

Under Pressure

However, when gasoline which was held under a storage pressure of 30 pounds was tested in a similar manner it was found that the vapor pressure indicated by the bomb was much lower than that pressure indicated by the gauge on the large container. Further study was then required to solve the mystery.

Going back to a previous statement made in this paper, that the pressure exerted is due to the vapor above the liquid, we find a plausible reason for the difference between the vayor pressure of the bomb and the vapor pressure of the container. Natural gasoline is a valotile liquid made up of a series of hydrocarbon compounds having a wide range of boiling points. To get an exaggerated view of just what happens when vaporization of a liquid like natural gasoline occurs, let

(Continued on page 82)

American Petroleum Institute Plans Refinery Technology Division

FORMATION of a Division of Refinery Technology may result during the meeting of the American Petroleum Institute in Chicago, December 6, 7 and 8. A committee has recommended that this as well as other divisions be created.

The refinery technologists, as well as production engineers and oil accountants, will meet in three group sessions the evening of December 7 in the Stevens hotel. There will be no programs. Recent announcements from headquarters of the Institute concerning this follows:

"Committees have recommended the creation of several new divisions of the Institute's activity, namely a Division of Refining Technology, a Division of Production Engineering and a Division of Oil Accountancy. If, after consideration of the recommendation and the financial problems involved in enlarging the Institute's activity, the board of directors authorize the formation of these new divisions, the members of the Institute present, can, at the sessions above referred to, proceed to make effective whatever plan of organization that may be authorized, including the election of chairman and vice-chairman and discussion of plans for divisional activity."

The demand for group meetings has been such that only one general session of the Institute will be held during the Chicago meeting. The announcement on this follows:

"Due to the demand for group sessions where specific topics can be discussed and to the pressure of business on the docket of the board of directors, only one general session will be held the afternoon of December 6. The president of the Institute will give his address and the report of the board of councillors will be received and the election of directors take place. At this session will be shown the new six-reel petroleum moving picture, "The Story of Petroleum," made under the direction of the Bureau of Mines in co-operation with the Institute."

Several of the group sessions will be of especial interest to those engaged in the refining branch of the industry. Foremost of these will be the group session on refinery practice, described as follows:

"All refinery men will be interested in the refinery technology group session where such problems as pipe still distillation, recovery of acid from sludge, vacuum distillation, vapor phase cracking and improved methods of treating cracked naphtha will be discussed."

Another session of especial interest will be on motor fuels, about which the following information has been given:

"The group session on motor fuel will be of especial interest to those interested in the motor fuel research program which has been under way at the Bureau of Standards the past several years. The work has been financed jointly by the Institute, the National Automobile Chamber of Commerce, the Society of Automotive Engineers and the government. Three papers covering distillation tests, engine acceleration and detonation will be presented by government representatives, and one on methods of measuring anti-knock characteristics of motor fuels.

"The co-operative research on motor fuel of these organizations has been in existence for a number of years and has proven of value in assuring the solution of problems of common interest to the automotive and the petroleum industries and has thus benefited the public."

Other group sessions of interest to the refiner include uniform accounting and transportation. Each will be taken up in several phases.

Directors whose terms expire concurrently with the Chicago meeting are: Mark L. Requa, engineer, San Francisco; B. B. Brooks, Consolidated Royalty Company, Casper; W. C. Franklin, Tidal Oil Company, Tulsa; J. D. Collett, Collett & O'Keefe, Fort Worth; Frank Phillips, Phillips Petroleum Company, Bartlesville; J. Edgar Pew, Sun Oil Company, Dallas; E. W. Clark, Union Oil Company, Los Angeles; T. A. Dines, Midwest Refining Company, Denver; P. M. Miskell, Empire Refineries, Inc., Tulsa; F. A. Pielsticker, Skelly Oil Company, Eldorado; Charles L. Suhr, Pennzoil Company, Oil City; E. T. Wilson, Continental Oil Company, Denver; H. B. Earhart, White Star Refining Company, Detroit; A. P. Coombe, Standard Oil Company of Ohio, Cleveland; H. E. Fleton, Union Tank Car Company, New York; A. B. Macbeth, Midway Gas Company, Los Angeles; D. E. Buchanan, Chestnut & Smith Corp., Tulsa; Herbert L. Pratt, Standard Oil Company of New York, New York; E. L. Doheny, Los Angeles; J. F. Lucey, Lucey Petroleum Company, Dallas; George H. Jones, Standard Oil Company of New Jersey, New York; Wallace E. Pratt, Humble Oil & Refining Company, Houston; E. C. Lufkin, The Texas Company, New York; Thomas A. O'Donnell, California Petroleum Company, Los Angeles; William N. Davis, Phillips Petroleum Company, Bartlesville; E. B. Reeser, Barnsdall Corporation, Tulsa; H. F. Sinclair, Sinclair Consolidated Oil Corporation, New York; George S. Davison, Gulf Oil Corporation, Pittsburgh; J. W. Van Dyke, Atlantic Refining Company, Philadelphia; Henry L. Doherty, H. L. Doherty & Co., New York; L. V. Nicholas, Independent Oil Men of America, Chicago; W. S. Fitzpatrick, Prairie Oil & Gas Company and D. M. Folsom, also the place made vacant through the death of J. C. Donnell.

Natural Gasoline Association Group Meeting Held at Breckenridge

Breckenridge, Texas. — The Natural Gasoline Association of America holding a one day meeting of plant operators here November 29, had an attendance of over 200 interested and enthusiastic men representing practically all of the 32 natural gasoline plants operating in the immediate vicinity, and from a large number of other plants operating in surrounding counties. This group meeting, fostering the open discussion of plant operating problems by men intimately acquainted with the details of operation, was well attended at both the morning and afternoon sessions, and its practical value to those in attendance was manifest by the brisk discussion of the papers presented.

Dr. E. R. Lederer, vice president of the Texas Pacific Coal and Oil Company, was in charge of the fall group meeting, and during the discussion of various operating problems he presented some interesting and valuable information from the chair. A. V. Bourque, secretary of the national association, addressed the meeting upon the completion of the afternoon program, and in addition to outlining the work of the organization, told the operators something of the scope of the scientific research program undertaken by the association.

Much interest was evoked in the open forum discussion of F. B. Goods' paper dealing with water treatment and the construction of water treating plants and equipment. John O'Conner of the Gas Engineering and Construction Company, opened the meeting with a talk under the subject of "Operation and Maintenance of Two-Cycle Gas Engines." His remarks in the matter of the A. W. Hubbel patents, covering the scavenging device which increases greatly the efficiency of two-cy-

(Continued on page 96.)

Analytical Gas and Gasoline Fractionation at Low Temperatures*

By LESTER O. WARNER,
Barton, Manning and Warner

IT has been stated that the "efficiency of an industry is no greater than the efficiency of its testing practice." This is doubly true when applied to the natural gasoline industry, an industry which is inherently dependent upon the results of its tests, dealing as it does in the "hidden values" occurring in an invisible medium—gas.

On an average, the constitution of natural gas is the same as it was when the industry began, but the character of the product has been changing continually. Viewed from this standpoint it is easier to justify "rule of thumb" methods. The pseudo relationship between specific gravity of the gas and the gasoline content, the per cent solubility in various oils and the variety of small scale absorption testing methods were of value at the time they were used, but they are now obsolete, except in special cases.

Only a few years ago the Newton test was in its prime. New plants in the Signal Hill field showed poor extraction measured by this test. Plants were continually changed, and as the pressure in the wells dropped, the plant efficiencies improved. What proportion of the indicated gasoline content was caused by new gasoline constituents? We cannot say, for the test was empirical. During this same period the charcoal test was employed. It was found that more gasoline was shown to be present by this test than was being produced in the majority of plants and great changes were made until the plants approached the production indicated. However, even this test is empirical and the same procedure cannot be used in every case to attain the desired or maximum results. It is not to be expected that the charcoal test can be made to give absolute results as it depends upon quantitatively condensing the gasoline fractions from the mixture of hydrocarbons, air and the carbon dioxide which is generated during the distillation. No empirical test has been found satisfactory in the study of variations in quality of gasoline and it is our opinion that distillation recovery alone is not a satisfactory index of stability.

The Objective

The object of low temperature fractionation is to eliminate as many variables as possible. Instead of merely separating the gas into a gasoline and a non-gasoline fraction (the object of previous empirical tests), the properties of which are dependent upon the relative proportions of constituents which compose them, in fractionation the gas is resolved into its different components so far as is practical. It is then possible to observe the changes in properties which take place with a variation in the proportion of the constituents.

There are so many hundreds of hydrocarbons in petroleum and so many are present in natural gas that even were they all separated the information would be of little practical value. It has been found that the properties of a mixture of hydrocarbons are influenced to a much greater extent by the lighter members than the heavier and, fortunately, it is easier to quantitatively separate the lighter constituents than the heavier. The following table gives the hydrocarbons which have been identified as occurring in natural gas in the order of their boiling points:

Methane.
Ethane.
Propane.
Iso Butane.
Normal Butane.
Normal Pentane.

Many of the earier investigators reported the presence of unsaturated hydrocarbons in natural gas because a contraction in volume was observed upon treatment with fuming sulphuric acid. More recent work has shown saturated hydrocarbons will dissolve to an appreciable extent in fuming sulphuric acid and that unsaturated compounds do not occur. There are, however, aromatic and cyclic compounds but these all have higher boiling points and lower vapor pressures than pentane. Due to the increasing difficulties of separation and measurement of these higher boiling constituents it is customary to report the residue as a group consisting of pentane and heavier.

Historical Development

The development of low temperature fractionation has covered a number of years, and cannot be called new. Nearly all of the present fractionating apparatus is dependent upon the same principles used over twenty-five years ago. The theory will be discussed in more detail later. Apparatus for the analytical separation of hydrocarbons followed in design and principle the excellent work of Ramsey and Travers in separating the gases of the atmosphere.

Work in other countries, notably that of Erdman and Stoltzenberg in Germany (1910) and Lebeau and Damiens in France (1913) and many others extended the work of Ramsey to the separation of various hydrocarbons. In this country credit must be given to Burrell, Siebert and Robertson, U. S. Bureau of Mines (1915) for the first complete procedure for the analytical separation of natural gas into its constituents. The process was slow and tedious and was greatly improved upon by Shepherd and Porter, also U. S. Bureau of Mines (1920-21), who reported the previous method required from 36 to 48 hours of continuous operation. About this time the Carbide & Carbon Chemicals Corporation conducted research upon the characteristics of gasoline, using an apparatus the details of which have never been disclosed. The time required for their analysis has been reduced to a few hours.

At one of the early meetings before this organization the need of a more precise method of determining the gasoline content of natural gas was stressed. It is interesting to observe that since that time three of the largest producing and refining companies in California have developed low temperature fractionation systems and a fourth is using a low temperature charcoal fractionating system.

Sampling

Before considering the actual separation procedure the samples must be obtained from the plant, pipeline or other source. The problem of obtaining samples that accurately represent the material, whether gas, gasoline or oil, is as important as any other step, and too much care cannot be taken. The difficulties encountered can be appreciated only by those who have to solve these problems. Every change in temperature, pressure and even contact with rubber and water will change the composition to some extent. All connections should be as short as possible and thoroughly purged. In sampling gas, care must be taken that an oil spray is not carried into the sample container, which is best made of glass. When gas is collected over water the bottle should be purged, displacing the water as completely as possible, reducing the quantity of dissolved gases to a minimum. It is obvious that rich vapors which will condense upon the walls are most difficult to handle. Although the sample container may be heated in the laboratory before removing any gas, results are liable to be erratic. Gases of low gasoline content, which are difficult to test by other methods, are more easily handled and the sampling errors are minimized.

It is theoretically possible to make a gasoline balance through a plant but such a procedure is not practical. Plants are not arranged so that representative samples over the necessary time interval can be taken. Variations in inlet gas quality, leakage of vapors and heads of vapor all

*Presented before fall meeting of California Natural Gasoline Association, Los Angeles, November 15 and 16, 1927.

combine to reduce the reliability. Errors in gas and gasoline measurement further increase the errors of such a balance. The gasoline content of inlet gas can be determined best by adding the actual gasoline production to the amount found by analysis in the gas leaving the plant. In this way the error of only one meter measurement, gasoline measurement and sampling is introduced.

Equal care must be employed in handling and storing samples until the analysis is made, which may be delayed weeks.

Procedure

Since the actual designs of apparatus for fractional analysis differ considerably, the procedure will also vary. The procedure will be treated from theoretical considerations only in order not to disclose confidential information.

For the benefit of those unfamiliar with the properties of the lighter hydrocarbons at low temperatures, let us consider the following analogus experiment. A glass bulb of about 100 c.c. capacity which has previously been evacuated is filled with equal volumes of a gas which may be air and water vapor. At 100 degrees C. the mixture would appear as a gas. The air may be compared to methane and water to ethane. As the bulb is cooled, more and more water will condense on the walls just as ethane will condense from a hydrocarbon mixture at the temperature of liquid air. At 0 degrees C. the quantity of water remaining as a vapor in the air is only a fraction of the total and the air may be pumped out until the vapor pressure of water is approached, after which the water would be evaporated. The water remaining contains dissolved air and likewise the ethane residue of a fractionation contains dissolved gases. It is obvious that by removing the gas at lower temperatures a more complete separation can be made.

The separation of the methane is not a true distillation and depends upon the temperature being so adjusted that no appreciable ethane distills off with the methane.

The sharpness with which two members of a hydrocarbon series can be separated by distillation is dependent largely upon the ratio of their vapor pressure at any particular temperature. From data of Burrel and Robertson the formulas for the relationship of log. ratio to absolute temperature have been derived. They are, as follows:

$$C_2H_6 = 0.247 + \frac{152.3}{T}$$

$$\text{Log R } C_2H_6$$

and

$$C_3H_8 = -0.221 + \frac{240.8}{T}$$

$$\text{Log R } C_4H_{10}$$

Similar ratios may be obtained for other mixtures if vapor pressure data are available. At a temperature such that the vapor pressures are in the order of millimeter the ration is 10 to 20, but atlower temperatures the ratios increase rapidly.

The separation of propane from normal butane is complicated by the presence of an isomeric form of butane. At atmospheric temperatures iso-butane has properties between propane and butane but closer to those of butane. Ext. note—At low temperatures approach propane.

No reliable data were available regarding the vapor pressure of pentane but the vapor pressure ratio of butane to pentane increases at lower temperatures.

The appartus, which is constructed entirely of glass, consists of a gas buret, a series of distillation bulbs which can be cooled to the proper temperatures, a pressure gauge for low pressures, a gas transferring pump. Provision is made for the final measurement of the fractions.

The entire apparatus is evacuated before admitting the sample. The sample usually contains no CO_2 or O_2 as these are removed in an Orsat apparatus to determine CO_2 and air content. The gas buret should be capable of measurement within one part in 500. If the buret is used at atmospheric pressure, corrections should be made for deviations from Boyles law (ref. Burrell). The sample after measurement is transferred into the bulbs for the purpose of separating the mixture into a series of approximately binary mixtures. This may be accomplished as described by Shepherd-Porter (loc. cit). These mixtures are then held successively at such temperatures that only one constituent (the lowest boiling) has an appreciable vapor pressure. This is the step in each separation which must be made at the lowest practical temperature, the time required for the removal of the constituents being the limiting factor rather than theoretical considerations. In other words, the separation should be made under conditions which permit the highest possible ratios of vapor pressure.

The measurement of pentane and heavier constituents at atmospheric pressure is not reliable and the methods employed by other operators are not known.

Proof of Accuracy

What proof is there that the fractions removed are pure compounds and that they are actually the constituents they are assumed to be? The mere fact that the total of the fractions is 100 per cent of the sample is in itself no proof. It only indicates accuracy in manipulation.

The cryogenic laboratory of the Bureau of Mines has used two methods for demonstrating the accuracy. One method based upon the combustion analysis is only moderately accurate, each constituent yielding carbon dioxide upon complete combustion in accordance with the chemical structure. The only assumption involved is that lighter and heavier impurities are not present in equal molecular proportions.

The other method employed was to make up a hypothetical gas mixture of carefully purified constituents in known proportions and analyze the mixture by the procedure described. The results obtained in this way checked the known composition within 0.1 per cent.

A method which lends itself to routine checking and has proved most satisfactory for testnig the purity of separated components is described by Shepherd-Porter. It is "based on the fact that the vapor pressure of a pure substance does not change as the ratio of the liquid volume to the gas volume is varied."

Applications

Now that we have described to you at some length the problem itself, the theoretical considerations involved, and the general development of the apparatus for the separation of natural gas into its actual constituents, we will try to answer the question which has probably occurred to most of you: that is, "What is the practical value of this complicated and expensive analytical method?"

The method in its present state is not a routine test and will not replace the charcoal method of determining gasoline content. For brevity, we will enumerate uses for this method which suggest themselves:

1. An umpire or referee test to be used to settle disputes.
2. A means of improving and standardizing empirical testing methods.
3. It may be used to compare and correlate results of empirical tests on gases and gasolines of different characteristics, whether from the same or different fields.
4. It leans itself to the control of exacting processes to which empirical tests cannot be applied, an outstanding example of which is the stabilizer.
5. It is the only logical method for determining the absolute efficiency of commercial equipment for which the industry spends millions of dollars annually.
6. It makes possible the study of the properties and characteristics of new mixtures of petroleum products and the development of new products with specific properties.
7. And data obtained from accurate analysis will be a guide to the design of more efficient equipment which will save for the industry many times the amount spent in research and development.

To summarize, the low temperature fractionation is a standard reference test in which the precision is always greater than the precision of commercial application. For all practical purposes, therefore, such an analysis may be safely considered as the ultimate and the development is capable of satisfying the most exacting demands of research.

The possibilities of such a tool are bound to be realized by the type of engineers found in the natural gasoline industry.

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Caustic Added to Charging Stock Counteracts Corrosion

Crystal Oil Refining Corporation has worked out numerous improvements at Cedar Grove plant

By GEORGE REID

IN the past year the Crystal Oil Refining Corporation, Shreveport, Louisiana, has engaged in, and for the greater part completed, an extensive expansion and rebuilding program at its Cedar Grove refinery. Through the installation of efficient bubble type fractionating columns, a 5000-barrel capacity tubular retort and conjunctive bubble type fractionating equipment, the skimming plant has been converted into a modern installation. The skimming battery of stills has been subject to thorough repair and improvement and the tube still equipment through which fuel oil residuum, direct from the battery of shell stills, is reduced to gas oil for charging stock for two Jenkins cracking units, is productive of benzine, distillate and gas oil—leaving a fuel oil residuum of marketable specifications.

The installation of bubble towers replacing baffle equipment where closer fractionation was required, has been conducive to the elimination of redistillation of skimming plant products, and has enabled the company to increase its daily through-put of crude to 16,000 barrels. Bubble type towers are also installed on the shell still employed for re-running pressure gasoline, and in conjunction with the operation of the tube still. The Jenkins units are of the latest type and design having a capacity of 1400 barrels each, daily.

The new equipment was designed with the view of attaining highest efficiency in heat conversion and the lowering of fuel costs not only by the interchange of heat, where possible, but by conserving and utilizing heat in flue gases formerly wasted, in the preheating of air entering furnaces. Heat energy is also reclaimed from all exhaust steam.

The tube still is equipped with a recirculating fan device which preheats the air for the air-gas mixture burned in the furnace, and through the employment of special burners in this connection important savings in fuel cost are effected. Fuel cost for this tubular retort has been reduced to one per cent of the fuel oil residuum charged to the still for reduction.

Charging Stock Mixed

Operating at its capacity of 16,000 barrels daily the crude oil charged to stills consists of a mixture of oils from nearby fields such as Pine Island, Caddo, and Bull Bayou, and a large proportion of Smackover, Arkansas crude.

Since much of this crude, especially the Smackover production is corrosive, due to its content of sulphur, salt, and magnetism chlorides, the oil is charged to the preheaters with a small amount of caustic solution. The caustic is taken into the charging pump through the suction and discharged with the oil to the preheater tank. The sodium hydroxide employed for this purpose is for the most part spent caustic which has been used at the chemical treating plant and is ready to be discarded. The caustic is blown to a tank near the charging pumps where it flows by gravity to two 50 gallon drums mounted on a small platform close to the pump and just high enough so that the caustic will flow into the crude oil suction line by gravity.

The caustic, about 18 degrees gravity, is permitted to enter the crude at the rate of approximately 50 gallons to every 1200 barrels of crude run. This is governed, of course, by frequent testing of the streams—which are held slightly alkaline, or showing no acid reaction. The results of the injection of this caustic into the crude during the past few months are of much interest, for the practice has certainly retarded corrosion to a marked degree, and after six months of use, the shell stills show no ill effects due to caustic accumulation on the bottoms . Prior to this practice it was often necessary to take stills off the line about once every 30 days for the repair of condenser coils or vapor lines, due to corrosion. Present practice has virtually eliminated the frequent shutdown periods for coil repair.

The charging pump discharges the crude into a preheating tank where the cool crude is preheated to about 150 F. by exhaust steam. The steam is derived from the exhaust side of the many steam pumps used in the plant operations. The preheater is a cylinder 20 feet by eight feet, through which the cool crude is charged through coils which are heated by the surrounding steam.

New Bubble Towers

Leaving the preheater the crude passes through heat interchanger and separator into the still battery. The cylindrical, horizontal exchanger is well insulated, 40 feet in length and nine feet in diameter containing 4200 feet of two-inch pipe through which the raw crude is pumped. This interchange with the hot residuum leaving the last still in the battery effects a raise in temperature to 300 to 325 F. At the separator or settling tank the hot crude drops any basic sediment or foreign matter which is carried in the crude, such as salt, which is usually present in the Smackover production. Transfer lines and separator are heavily insulated and little heat is lost while the oil is moving from the interchanger through the separator and into the first still—reaching this still at temperatures ranging also from 300 to 325 degrees F.

There are nine shell stills in the battery which are 36 feet by 12 feet in dimensions. Straight run gasoline cuts are taken from the first five stills in the battery. The sixth still is cut out and is being used for rerun of pressure products. The seventh and eighth stills produce kerosene, with gas oil as the overhead product derived from the ninth or last still. Bottoms from this still are 16 to 18 gravity fuel oil and are employed as charging stock for the tube still.

The bubble type fractionating columns installed on the fifth and sixth stills are the design of the Winkler-Koch Engineering Company and have replaced the towers of the baffle type. Baffle towers remain installed on the other stills since the sharp fractionation secured by bubble tower operation is not required from them.

Something of the efficiency of the bubble tower installation employed at present is manifest by the fact that the initial boiling point of the bottoms in the fifth still run from 10 to 15 degrees higher than the end point of the gasoline produced overhead from the towers, or a "negative gap" ranging from 10 to 15 degrees is secured.

Still bottoms from the fourth still are passed into the bubble tower as a reflux or recycle medium, and the vapors rising from this still pass through the pools of hot oil flowing downward over the bubble plates in the usual manner of bubble type tower operation.

The tower consists of two sections, the lower compartment being 21 feet high and eight feet in diameter. Manheads, or inspection plates are provided at each bubble tray or plate. The upper compartment or section of the tower is 42 feet in height and six feet in diameter. Hot still bottoms from the fourth still are forced into the lower compartment of the tower by a steam jet, and conducted into the tower through one of three inlet lines provided for this purpose. Through the use of three lines, the proper point of entry for the recycle media, hot, partially stripped crude in this instance, may be selected, which makes for better control of operation. The bottoms after flowing

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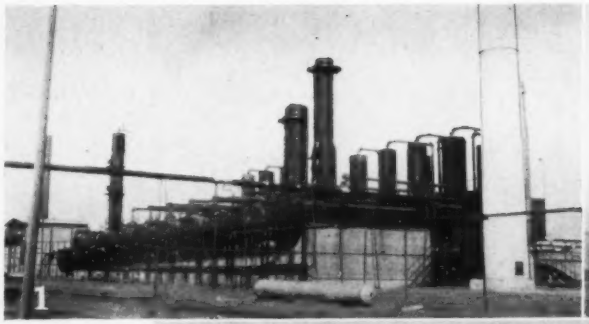
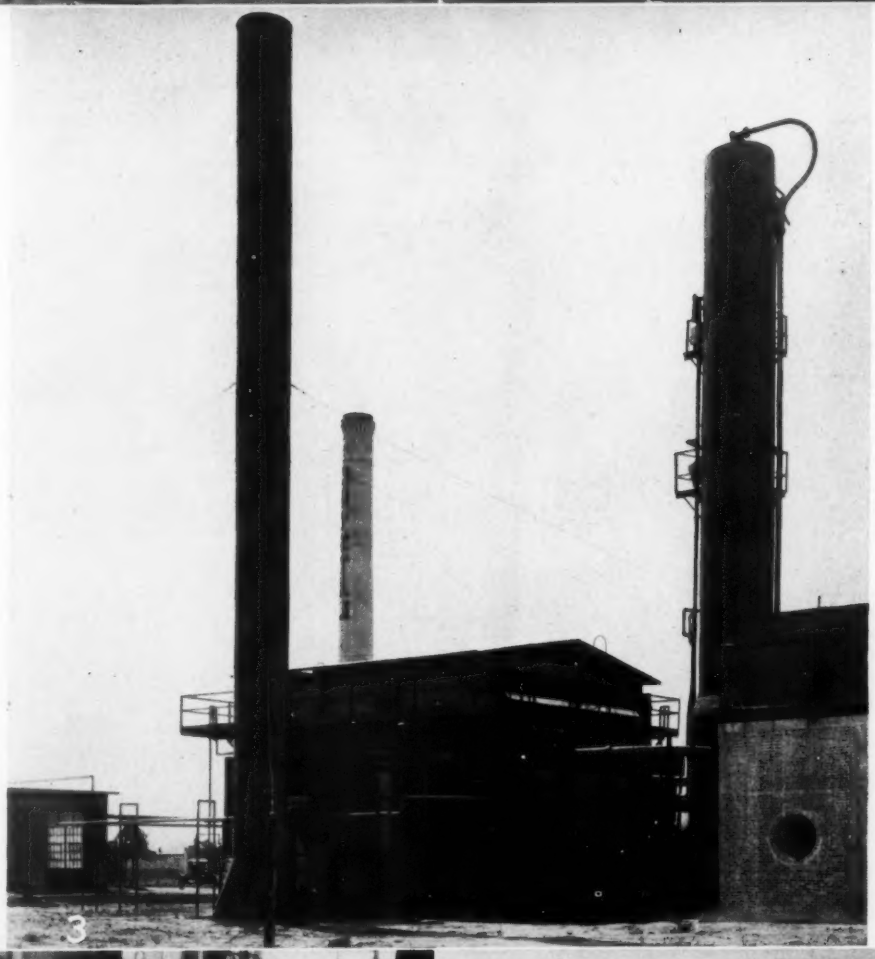




VIEWS OF CRYSTAL OIL REFINING CORPORATIONS PLANT AT CEDAR GROVE, LOUISIANA.

1.—THE HIGHER COLUMNS ARE NEW FRACTIONATING EQUIPMENT. 2.—JENKINS CRACKING UNITS. 3.—FIVE THOUSAND BARREL TUBULAR RETORT. 4.—INTERIOR OF POWER HOUSE. 5.—RUN-DOWN TANKAGE.

Using Chemicals Protects Distillation Equipment Against Corrosion

By GUSTAV EGLOFF and JACQUE C. MORRELL
Jacque C. Morrell Research Laboratories, Universal Oil Products Company, Chicago, Illinois

One of the most critical and urgent problems in the petroleum industry is the prevention of corrosion, particularly of distillation equipment. The economic losses due to corrosion, are hig, not alone from the cost of replacement, but also from loss of time and curtailed production. The present communication considers the injection of chemicals into refinery equipment in order to neurtalize the corrosive substances resulting from the atmospheric and superatmosphere distillation of petroleum oils.

A number of metallurgical methods have also been suggested for controlling corrosion during the pressure distillation of oils of relatively high sulphur content; some of them have gone into commercial use.

1. The manufacture of pressure-still equipment from highly resistant alloys such as chrome iron or chrome steel.
2. Electro plating with such metals as chromium.
3. Lining reaction-chambers with chrome iron, aluminum, or other corrosion-resisting metal or alloy.
4. Coating the surfaces with a corrosion-resulting metal or alloy by means of welding appliances.
5. Coating the walls of the chamber and dephlegmator with corrosion-resisting elements or alloys by means of spray-guns.
6. Using calorized steel surfaces.
7. Lining reaction chambers and dephlegmators with plates of mild steel and replacing them as they corrode.

Another protective measure is the spraying of the inner walls of the various parts of the cracking system, especially the reaction chamber, with a film or layer of corrosion-resisting material which will adhere firmly. Sodium silicate alone or mixed with various materials in suspension, such as lime and furnace cement, have been tested.

Reagents which have been used for minimizing corrosion are sodium hydroxide, ammonium hydroxide, sodium carbonate, and hydrated lime. These substances are usually introduced into the system by means of direct-acting pumps. The results obtained indicate that corrosion is reduced over 50 per cent by the use of amounts of chemicals that are relatively small in comparison with the quantities required to neutralize all the corrosive substances.

The chief difference in the use of the various reagents mentioned depends upon the particular application; and while all these reagents neutralize corrosive substances, such as hydrogen chloride and hydrogen sulfide, the choice of the particular reagent depends upon the type of oil undergoing distillation and the method of operation of the equipment. For example, while sodium hydroxide is a stronger base than lime and is just as effective or perhaps more so, in neutralizing hydrogen sulfide, lime presents fewer operating difficulties and has other advantages which will be discussed later.

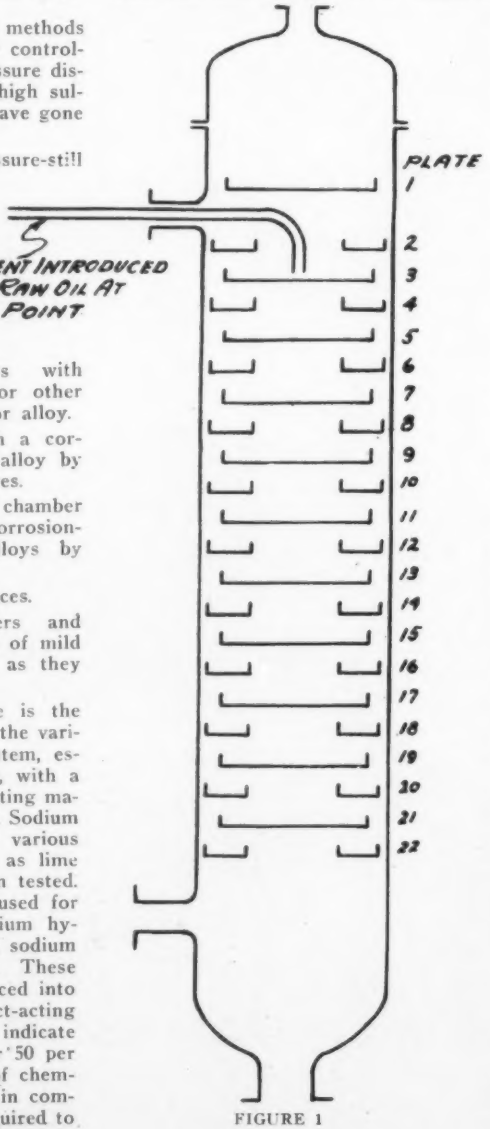


FIGURE 1

Ammonia is not only itself unstable, but the sulfides formed decompose at the temperature of cracking. It is used principally for neutralizing hydrogen chloride in the condenser. However, mixtures of ammonium hydroxide with sodium hydroxide have been used to advantage in pressure stills. Ammonia is the only volatile neutralizing agent of the group, hence it has particular value in neutralizing corrosive agents in the vapor zone, whereas the other reagents must effect practically all of the neutralization in the liquid phase.

Sodium carbonate, while containing only 75 per cent of the alkali content of sodium hydroxide, calculated as Na_2O, is much cheaper per unit of alkali.

The General Method of Injection

Ammonia is used principally to neutralize hydrochloric acid resulting from the hydrolysis of chlorides of the alkaline earth metals, magnesium and calcium. The ammonia or aqua ammonia diluted to a suitable concentration, may be introduced directly into the vapor line leading to the condenser. The advantage of the aqua ammonia is that it dilutes the hydrochloric acid while neutralizing it.

Caustic soda or soda-ash is injected into the system by making up solutions of proper concentration and regulating the amount fed. A suspension of hydrated lime is made and fed into the system in a manner similar to that for caustic soda and soda-ash.

The favorable point of introduction in a cracking system has been determined by trial and the place found most satisfactory at present is the charging-oil line which leads to the dephlegmator or the heating tubes, or to both. The solution entering the feed-line mixes with the oil to be distilled. The water evaporates from the alkaline solution in the dephlegmator, leaves the system with the oil vapors, condenses with the oil distillate, and collects with it in a receiver. The chemical reagent is dispersed in the oil and passes through the heating element to the vaporizing chamber. The amount of reagent used is small and likewise the quantity of water. The chemical reagent is introduced uniformly in proper concentration into the system, and no detrimental effect upon the operation of the cracking units has been observed.

As the segregation of lumps of the

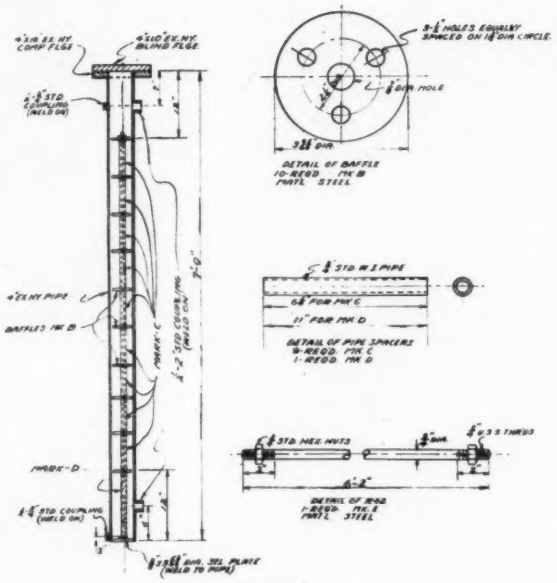


FIGURE 2

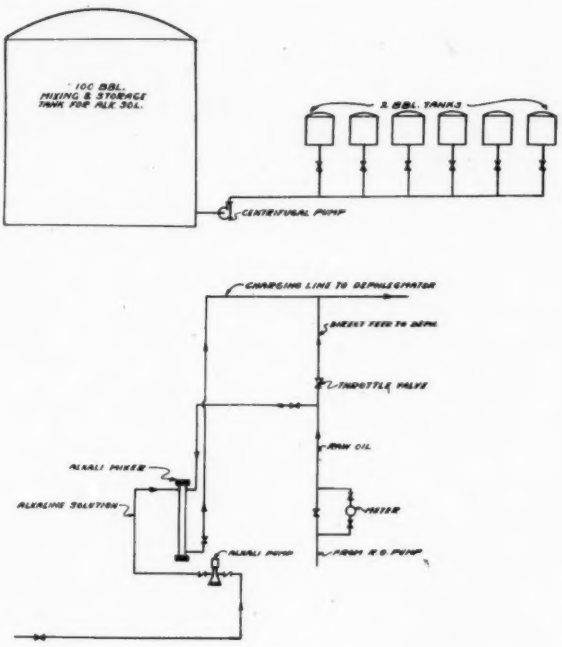


FIGURE 3

reagent is detrimental, a thorough dispersion throughout the oil is desirable. To accomplish this, the oil, or a part of it, and the reagent are passed through an orifice mixing-column and the mixture of oil and reagent is then passed into the raw-oil line leading to the dephlegmator. The details of such a column are shown in Figure 1.

Design of Mixing Column and Arrangement of Equipment for Introducing Reagents

The Design of the Mixing Column:

In order not to place too great a pressure upon the charging pump, the amount of the back pressure is fixed, e.g., at 10 pounds. Using 10 plates, the pressure is one pound per plate. For the average fuel oil of specific gravity 0.9, this pressure is equivalent to a head of 2.55 feet per pound, calculated from the formula:

$$Q = ca\sqrt{2gh}.$$

Q = flow in cubic feet per second.

Where: c = discharge coefficient=0.65.

a = area of orifice in square feet.

g = gravity acceleration=32.2 ft. per sec.

At 1100 bbls per day, or 46 bbls. per hour, the total orifice area per plate would be 1.33 sq. in. equivalent to the total area of three one-half-inch diameter holes equally spaced on the plate as shown in drawing No. 2, when allowing an all around clearance for the plate of one-sixteenth-which is equivalent to a clearance of 0.736 square inches.

Construction of Mixing Column:

The full details of the construction of the orifice column are shown in Figure No. 2. A seven-foot length of four-inch extra heavy pipe is used. The plates are welded to the rod as shown.

A combined mixing and storage tank is used for the reagents. Figure No. 3 shows the arrangement of a storage tank with small feed tanks attached for six cracking units, each converting 1100 barrels of oil per day into more than 50 per cent of gasoline. The feed tanks are connected in series with the storage tank by a centrifugal pump and are filled by manipulating the valve positioned at the feed tank. Each unit is fed from a separate feed tank connected as shown in Figure No. 3. The reagent is drawn from the feed tank

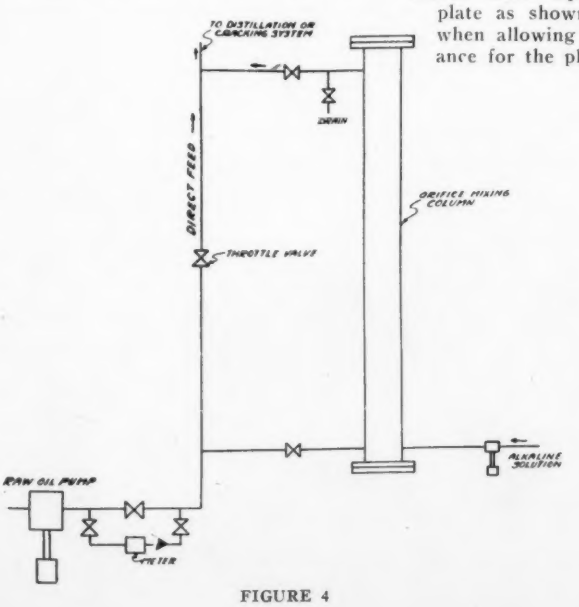


FIGURE 4

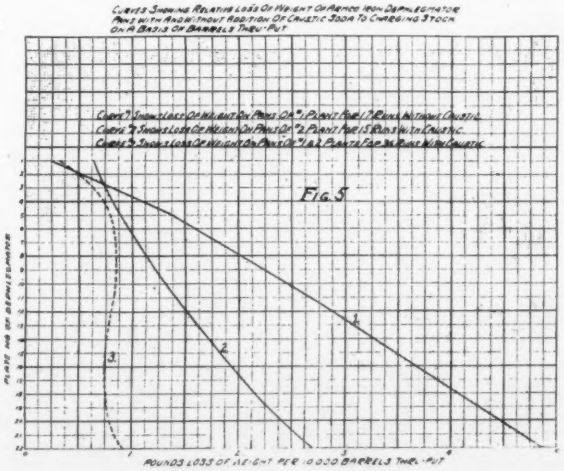


FIGURE 5

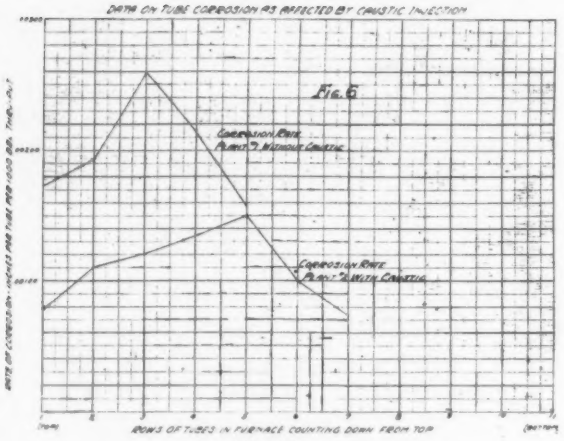

DATA ON TUBE CORROSION AS AFFECTED BY CAUSTIC INJECTION
Fig. 6
CORROSION RATE PLANT 2 WITHOUT CAUSTIC
CORROSION RATE PLANT 2 WITH CAUSTIC
ROWS OF TUBES IN FURNACE COUNTING DOWN FROM TOP

FIGURE 6

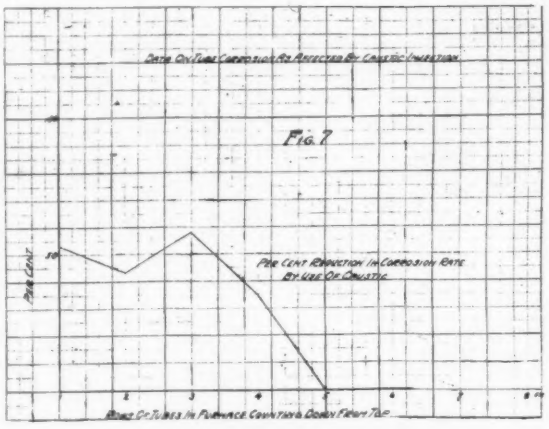

DATA ON TUBE CORROSION AS AFFECTED BY CAUSTIC INJECTION
Fig. 7
PER CENT REDUCTION IN CORROSION RATE BY USE OF CAUSTIC
ROWS OF TUBES IN FURNACE COUNTING DOWN FROM TOP

FIGURE 7

by means of a small plunger pump or reciprocating pump and fed into the orifice mixing column.

Arrangement and Operation of Chemical Injection Equipment

The two-barrel feed tanks are located at convenient points. The orifice column may be located anywhere near the plant, preferably along the outer wall of the receiver house. The arrangement of the lines to and from the orifice column is shown in Figure No. 3. The oil is charged by means of the raw oil pump having a meter and by-pass, with a throttle valve between the charging line which leads directly to the dephlegmator and the orifice column. Another valve interposed between the throttle valve and the orfice column permits by-passing of the latter, when desired. The reagent is fed in with the pump, and, together with the oil, enters into the top of the orifice column and is discharged at the bottom to the charging line of the distillation system, entering the dephlegmator or other points where it is found desirable to feed the chemical solution.

Figure No. 4 shows a similar arrangement, excepting that the alkali and oil enter the bottom of the orifice column and are discharged from the top. It is believed that the arrangement shown in Figure No. 3 is more satisfactory. The oil and alkaline solution throughly mixed are fed into the dephlegmator.

As stated previously, only a portion of the oil need be passed through the mixing column, and the mixture of oil and reagent then fed into the main stream of the oil. Under these conditions the orifice column must be designed for the smaller quantity of total liquid passing through, keeping the pressure factor the same. The lines for carrying the by-passed oil should be one-inch extra heavy pipe. The connection into the raw oil line can be made with tees and a valve should be placed directly after the tees, so that the whole injection system can be closed off when desirable. If a plunger pump is used, it may be operated separately by motor or may be attached to the rocker arm of the oil-feed pump. The chemical reagent line leading to the raw oil by-pass is connected as shown in the drawing. A tee with petcock should be installed directly after the orifice mixer so that samples can be taken from time to determine the degree of mixing.

Caustic Soda Injection

The caustic soda solution is made approximately of a gravity of 10 degrees Be. and is injected in the proportions of 0.2 to 0.3 per cent of the oil by volume. In the use of caustic soda, some difficulty has been observed in the deposition of the solid reagent or the reaction product, sodium sulfide, upon various parts of the heated system with resulting high rate of corrosion due to the protecting reagent itself. This difficulty is offset to a considerable extent by the use of the mixing system heretofore described, or by injecting the caustic soda solution in a more advantageous part of the distillation apparatus.

Another difficulty presents itself in the use of caustic soda; namely, the deposition of coke in the heating tubes is increased to a considerable extent. On the other hand, caustic soda has been known to give satisfactory protection when relatively small amounts have been used. The accompanying diagram, Figure No. 5, indicates the results obtained when caustic soda solution is injected into the dephlegmator of a cracking unit. The graph is self-explanatory and shows that the corrosion was cut down to approximately 50 per cent when compared to an operation using no chemical. In one commerical plant it has been reported that the coke deposition was cut down 80 per cent in the heating tubes by the injection of caustic soda in regulated quantities. Figures No. 6 and 7 indicate the rate of corrosion of the heating tubes in a cracking unit.

One method of determining the rate of corrosion is to place control samples of steel in various parts of the distillation system. These samples are

(Continued on page 98)

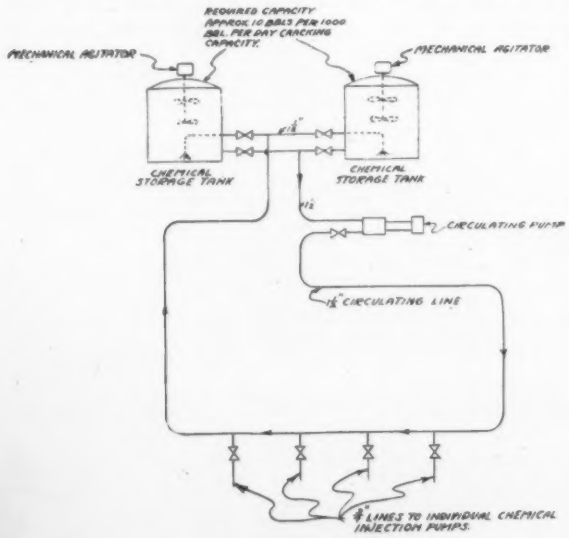

REQUIRED CAPACITY APPROX. 10 BBLS PER 1000 BBL PER DAY CRACKING CAPACITY.
MECHANICAL AGITATOR
MECHANICAL AGITATOR
CHEMICAL STORAGE TANK
CHEMICAL STORAGE TANK
CIRCULATING PUMP
CIRCULATING LINE
LINES TO INDIVIDUAL CHEMICAL INJECTION PUMPS.

FIGURE 8

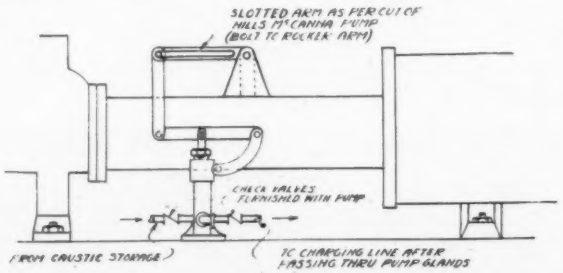
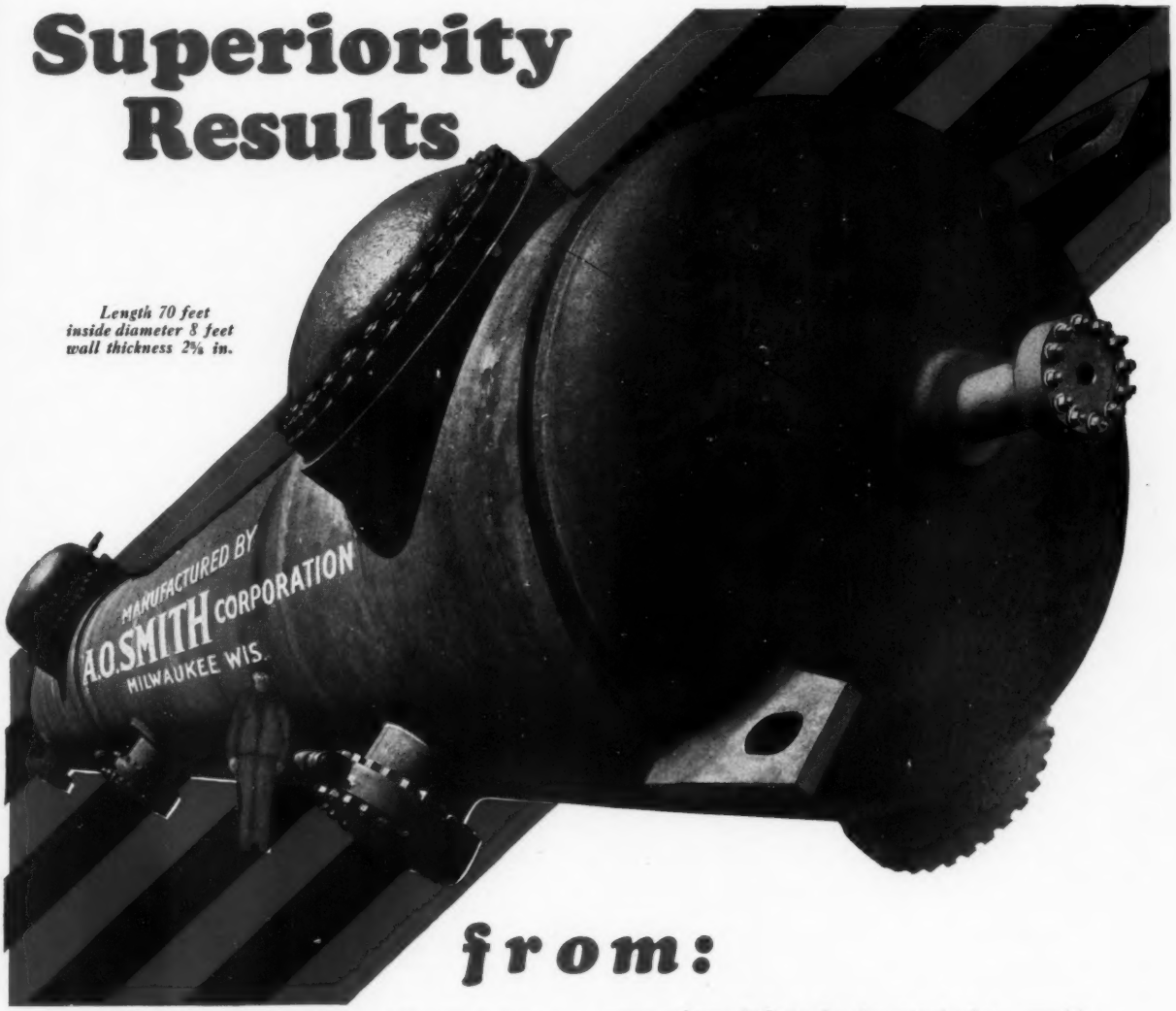

SLOTTED ARM AS PER CUT OF HILLS MCCANNA PUMP (BOLT TO ROCKER ARM)
CHECK VALVES FURNISHED WITH PUMP
FROM CAUSTIC STORAGE
TO CHARGING LINE AFTER PASSING THRU PUMP GLANDS

FIGURE 9

Superiority Results



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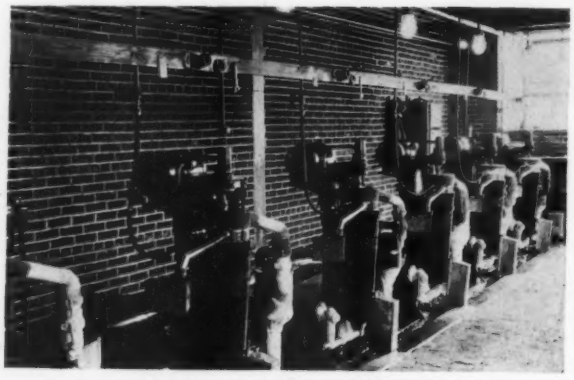


SIX SHARPLES SUPER-CENTRIFUGES

McKean Plant Accomplish Dewaxing In One Operation

By GEORGE REID

THE McKean County Refining Company, Bradford, Pa., of which Frank J. Moore is president, in the operation of its plant at Farmer's Valley, has perfected a process for the manufacture of lubricating oils from Pennsylvania crude which embraces the dewaxing of the entire wax bearing lubricating oil fraction in one operation or one pass through the system. The process simplifies the manufacture of lubricating oils to a great extent. Pressing, for example, which is one of the common methods of wax extraction, is eliminated. The usual step of pre-filtration before dewaxing is also omitted, as is the redistillation of wax distillate for dewaxing. This process also eliminates all blending and compounding for the preparation of lubricating oils.

The process has been successful during the past year under the supervision of Earl Petty, plant manager and refinery engineer for the company.

Before discussing the process in detail and the manner in which the manufacture of lubricating oil is simplified, it may be well to describe the plant equipment and the method of operation of the reducing units.

The McKean County Refining Company is also one of the organizations which have found it both safe and profitable to distill Pennsylvania crude with the conventional tube still. The company employs one Foster tubular retort, which acts as a heater through which the crude oil is circulated from a large shell still type separator.

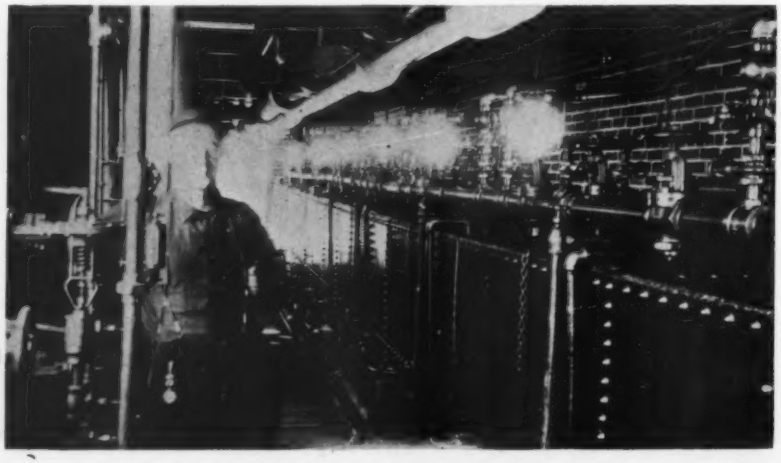
Operating Method

There are two of these separator chambers, one of which is charged, when starting up, with cool crude. The oil is then pumped through the coal fire tube still by means of a National Transit hot oil pump, size 12 by 8 by 24 inches, which circulates the oil to and from the separator at the required rate of speed, depending upon the stage of reduction, and at temperatures as high as 650 degrees F.

While the crude in one separator is being distilled by gradual increase in temperature through circulation through the tubes, the second separator is charged a Leach heat exchanger placed between the Bell Type bubble towers and Southwestern Type condensers. The incoming cool crude thus passes counter-current to the hot fractionated vapors leaving the tower, which exposure effects an increase in temperature sufficient to cause the vaporization of much of the lighter gasoline content of the crude going to this second separator.

In this manner the pipe still plant is kept in almost continuous operation, since the distillation of the crude in the first separator is usually completed by the time the second chamber is charged. The separators are not fired, but steam for agitation is provided. The distillation through circulation through the tube still effects the removal of the gasoline, naphtha, kerosene and fuel oil cuts with part of the operation being carried on until the wax distillate fraction is distilled.

In explanation of the last sentence above it is well to explain that the operation of this plant calls for the distillation or reduction of about 60 per cent of the crude charged to stills down to a 650 degree F. fire test on the separator bottoms.



INTERIOR VIEW OF FILTER HOUSE

The Spirit Of The Season Prompts Us To Express To You Our Best Wishes For A Merry Christmas And A Happy, Prosperous New Year

Henry Voot Machine Co.
Louisville, Kentucky.

In this operation, 60 per cent of the crude is reduced to cylinder stock. This steam refined cylinder stock, which contains the excess of coloring matter in a concentrated form, while it is marketed as such, could be cold settled and filtered for bright stock when the market justifies the additional processing. The crude thus handled is stripped of its gasoline, naphtha, kerosene, fuel or gas oil, and wax distillate. The latter bears all of the lubricating oil and all of the wax which is in the crude in the wax distillate fraction.

The remaining 40 per cent of the crude oil charged to stills is not reduced to such high fire test. This portion of the crude is stripped of its gasoline, naphtha, kerosene, and fuel oil or gas oil fraction, leaving in the still what might be termed a long long-residuum having a flash test of 390 degrees F.

Two Are Mixed

The next step involves the mixing of the bottoms remaining from the second operation which has the 390 degrees flash test, and is termed long long-residuum, with the wax distillate fraction derived from the distillation of 60 per cent of the crude charged to stills. With the exception of the cylinder stock which is segregated from 60 per cent of the crude, as described, this mixture of the wax distillate and the long residuum embodies all of the lubricating oil portion and waxes which are present in the original crude. This gives a partial manipulation of coloring matter which is necessary to accomplish dewaxing of such a wax distillate and long residuum stock.

There is, however, a mixture of three materials going from the distillation unit into the centrifuge plant for dewaxing. In the mixture of the long long-residuum and wax distillate there is still a predominance of crystalline wax, and in order to convert this stock into a suitable form of dewaxing by cold settling or centrifuging an agent which acts as a retardant is added prior to the dewaxing operation. While this agent can be secured in a chemical form, it is also at hand as a natural derivitive from petroleum and secured by the ordinary refining processes where lubricating oils are manufactured. In the operation of this process it not only serves as an agent, but becomes a stock from which valuable lubricating materials are recovered. Its purpose is that of insuring that all wax present will be converted into the amorphous form, which is deemed essential to dewaxing when based on the principle of difference in densities. The material which is used in small quantities is selected from crude oils of the same base and type as that being refined.

At this stage, just before dewaxing, the stock to be treated or freed of its wax, has been obtained without any filtration and with the minimum distillation, and this stock represents all of the lubricating oil and wax materials born by the crude-mixed into one cut or fraction.

The next operation, which is dewaxing, is accomplished by the conventional centrifuging methods, or by an improved cold settling method now being investigated at this plant. It may be well to state here that all of the process is held under patent by those interested in its perfection.

THE CENTRIFUGE PLANT

Centrifuging

Before centrifuging, the dewaxing stock is diluted with 60 to 65 per cent naphtha and chilled to 10 degrees below zero. After dilution and chilling it is centrifuged through a battery of 12 Sharples super-centrifuge machines. In this plant the crude wax is separated from the oil. This wax contains the white wax from the wax distillate and the petrolatum from the long rediduum in a peculiar combination. Instead of being crystalline wax, however, this product is amorphous wax, and thus becomes a special product of the refinery, for which there are certain important special uses.

The wax thus recovered can be further refined by distilling, or a white wax can be secured by pressing or sweating. Distillation of the wax can proceed with very little steam without fear of destroying valuable lubricating oils. The McKean Company, however, markets this amorphous wax without further refining and finds a brisk demand for it in certain special applications. The melting point of this type of wax is comparatively speaking, much higher than that of crystalline wax. Another method of recovering all of the oil in the wax without sweating, is to re-centrifuge the extire wax portion. The segregation of this wax, however, has been accomplished without any filtration or any additional distillation.

To Batch Stills

The oil recovered from the centrifuges is taken to a battery of batch stills, where the operation is really semi-continuous. Here the mixture of oil and naphtha is separated, the naphtha being distilled off and recovered for future use. Distillation is carried on for the removal of some light non-viscous neutral oils which have been dewaxed with the entire wax bearing lubricating oil portion from the crude. The over-head neutral oils may be re-distilled for maximum yield of viscous neutrals. When distilling or reducing to 465 degrees F. flash test bottoms in the shell stills, a considerable quantity of 200 viscosity oil of about 25-30 cold test is obtained.

The residue, or dewaxed material, which is topped to flash point, 465 degrees F., as mentioned above, is sent directly from the stills to percolating type filters and finished to No. 6 color, N. P. A.

When the yield of this material based against the crude is considered, it is remarkable that a No. 6 color can be produced, but it is recalled that a wax distillate fraction derived from 60 per cent of the total amount of crude oil charged to stills, has entered the stock.

The physical characteristics of the finished oil produced by this method are:

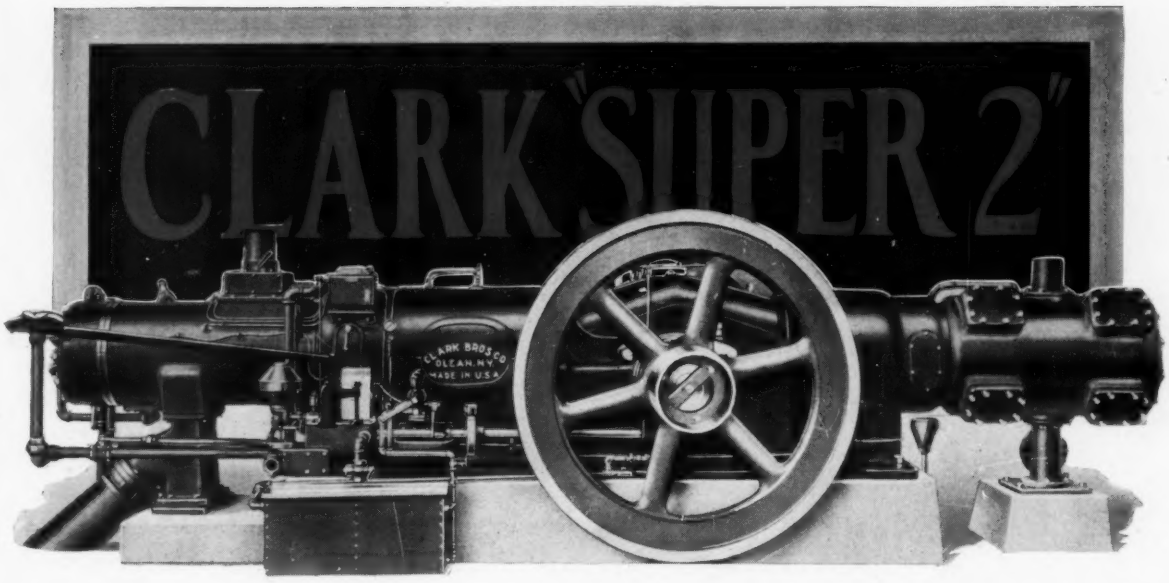
Gravity, 28-28.5 degrees A. P. I.
Flash, 465 degrees F.
Fire, 515-520 degrees F.
Viscosity at 210 degrees F., 68 to 70 seconds.
Cold test, 20 to 25 degrees F.
Color, No. 6 N. P. A.

These specifications are not rigid, for by less reduction in the batch stills after the distillation of the diluted naphtha, these specifications can be accurately controlled, and down to a minimum flash point of 420 degrees F. and a viscosity of 56 seconds at 210 degrees F.

The process is one of very economical operation, and the equipment generally necessary for lube oil manufacture is reduced greatly. By the elimination of "pressing," re-distillation for wax removal from wax distillate, the doing away with pre-filtration before dewaxing, certainly much better economy is secured. The lubricating oil is prepared in accordance with predetermined specifications in one pass through the system, and handling but one large fraction from the crude instead of many, and thus the matter of blending and compounding is virtually eliminated from the plant operations.

Absorption Plant

Amarillo, Texas.—Phillips Petroleum Company started construction work late in November on an absorption gasoline plant in the Bower-Jackson pool in Gray County section of the Texas Panhandle. This plant is located in section 88, block B-2, H. & G. N. Railroad survey, and will be equipped to handle about 10,000,000 cubic feet of gas daily. The oil in this particular area averages about 44 degrees gravity, and is practically free from sulphur, thereby making it one of the best natural gasoline plant locations in the Panhandle. Phillips also contemplates securing a carbon black permit to burn the residue gas from this plant, but the carbon black unit would be erected by another concern.



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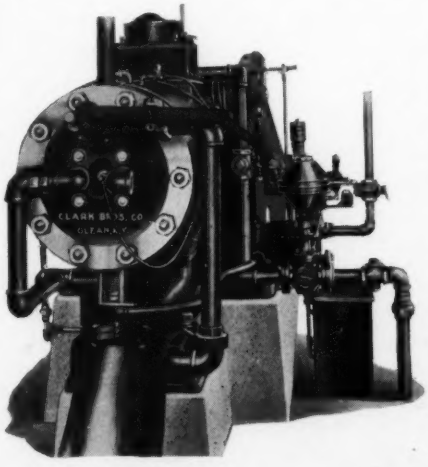

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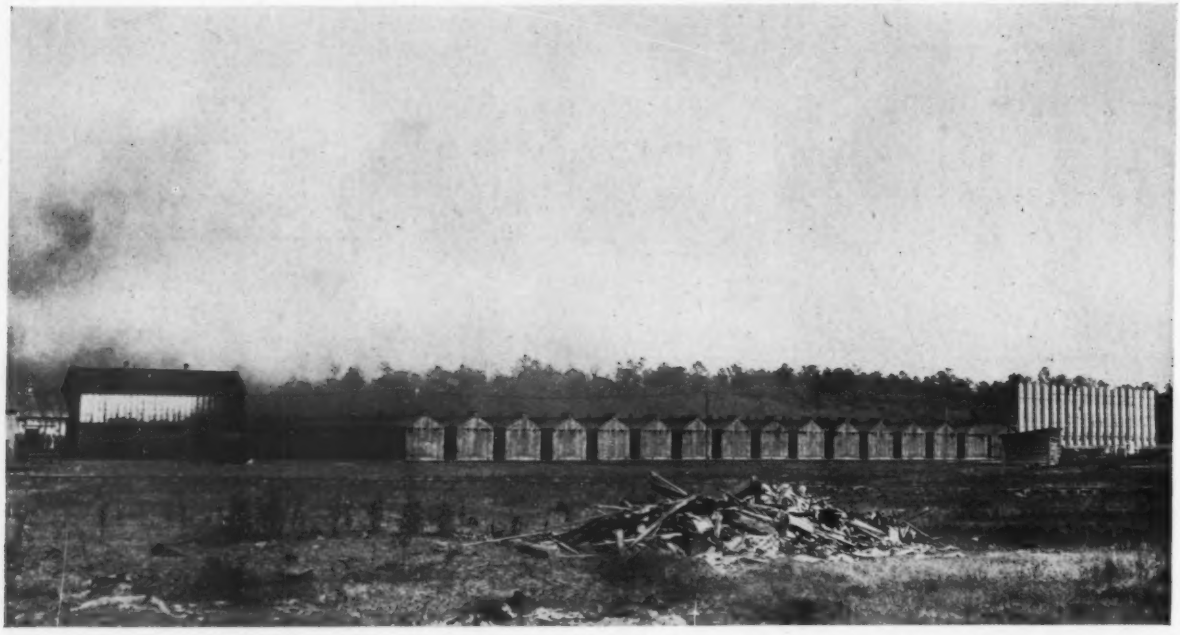


ONE OF SOUTHERN CARBON COMPANY'S PLANTS NEAR SWARTZ, LOUISIANA. THE ABSORBERS IN THE BACK GROUND ARE THOSE OF THE COLUMBIAN GASOLINE COMPANY, WHICH EXTRACT GASOLINE FROM THE GAS BEFORE BURNING FOR CARBON BLACK

Carbon Black Production Under Conservation Rules

Monroe gas field is source of much of country's carbon black and industry is conducted with due regard to exhaustion of gas supply

CARBON BLACK has of late years become of importance to the extent that two other great industries are essentially dependent upon its continued production for their functioning. Great quantities of this product are consumed yearly by the automobile and truck tire manufacturers and the dye and ink trades. When consideration is given the many millions of dollars invested in the rubber and printing industries alone, both dependent upon carbon black, the vital importance of this industry is forcibly brought into view.

Approximately 75 per cent of the carbon black production of this country is derived from the justly famous mammoth Monroe gas field in Northern Louisiana. The importance of that statement is further augmented by the fact that since the discovery of the gas reservoir in this section in 1916, the total production of "black" from Monroe gas is estimated at 675,244,834 pounds. During the first half of 1925 there was 64,331,000 cubic feet of gas consumed by the operators of carbon black plants in the Monroe field in the manufacture of 65,848,113 pounds of carbon black—at the rate of 1.084 pounds per thousand cubic feet.

Since the period just mentioned the portion of the industry operating in this largest productive center has through close co-operation with the Conservation Commission of Louisiana, and abiding by the regulatory rulings of that body, held production of natural gas and subsequent production of carbon black on about an even level.

Production of carbon blacy during the last half of 1925 was 64,313,473 pounds—or a little less than the production during the first half of the year. In 1926 production averaged about the same, with a total of 129,564,840 pounds reported. The first half of the current year has seen production maintained at about the same level, and at the end of June, 1927, total production of carbon black in the Monroe field was 60,088,008 pounds—or at the rate of about 10,000,000 pounds per month. Reports covering the later months of this year indicate a continuance of this rate of production, which in terms of daily production means about 335,000 pounds per day.

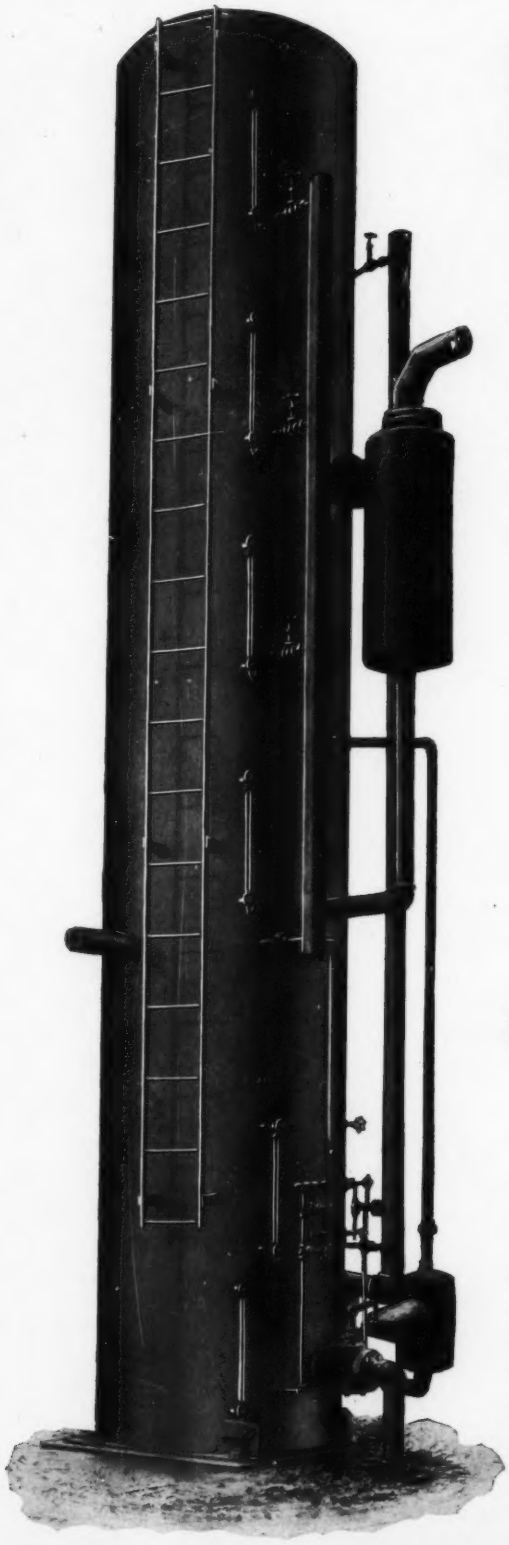
Conservation

Manufacturers of carbon black in Louisiana have willingly co-operated with State departments of conservation of natural resources for some years, which condition no doubt contributes greatly to the efficacy of Louisiana's conservation laws which now merit the attention of other States confronted with problems of conservation of petroleum and kindred resources.

According to the latest available figures the daily average withdrawal of gas from the entire Monroe field is 370,705,616 cubic feet, which great volume of gas is but 10.64 per cent of the "open flow capacity" of the field. According to the guage of the district the open flow capacity is 3,485,280,692 cubic feet.

The manufacturers of carbon black consume a daily volume of 244,346,000 cubic feet of gas which is 65.92 per cent of the daily average withdrawal

THE PROFIT PROCESS



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possess the following features: [1] *Simplicity of Operation* [2] *Ease and Rapidity of Erection* [3] *Low Initial Cost of Installation* [4] *Low Maintenance Cost* [5] *Portability* [6] *High Salvage Value* [7] *High Efficiency.*

A DISTINCTIVE feature of Newton plants is the distillation unit which utilizes the high efficiency of the absorber. The distillation unit denudes the oil to the point required for maximum extraction and converts the lower boiling fractions into a marketable product.

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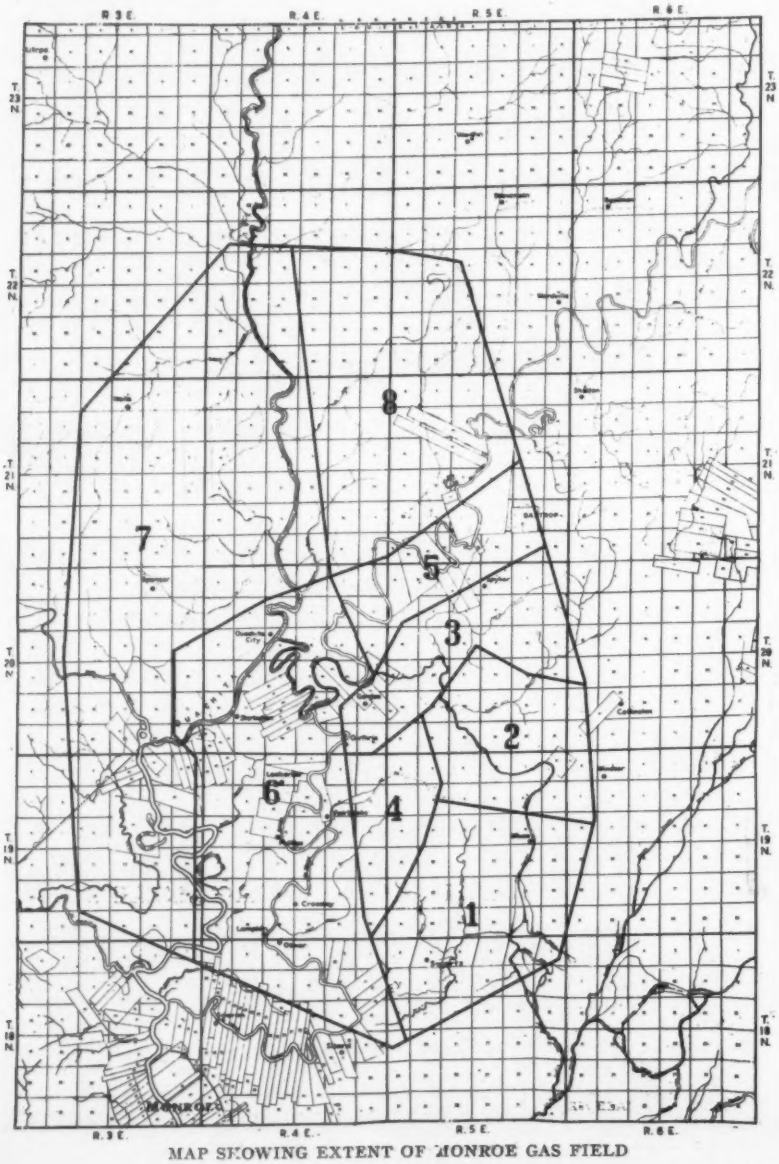
and 7.01 per cent of the open flow capacity of the field.

The daily average consumption for industrial and domestic use is 126,359,616 cubic feet. This is 34.08 per cent of the daily average withdrawal and but 3.63 per cent of the open flow capacity of the field. Thus approximately two-thirds of the gas production is consumed by the carbon black industry, and the reamining one-third transported from the field for domestic and industrial service. The field is located in a section not densely populated, with the nearest big market for industrial and domestic gas being the city of New Orleans. Cheap fuel has attracted some industry to the vicinity, and the recent completion of a gas pipe line to the refinery of the Standard Oil Company of Louisiana at Baton Rouge has materially increased the volume of gas consumed other than in the carbon black plants. The gas line leading south toward New Orleans, is 22-inch, and has been completed to within 18 miles of that city. The completion of this line southward, and a few additional industries in adjacent cities has increased the consumption of gas for domestic and industrial purposes from about 25 million feet daily early in 1926, to the present figure of 126 million cubic feet.

In 1924 the Louisiana legislature passed an act limiting the amount of gas which could be produced from wells drilled prior to June, 1924, to 20 per cent of the open flow capacity. Wells completed after that date were permitted a maximum of 24 per cent of the open flow capacity when one well was bored on each quarter section, 21 per cent is permitted when one well is drilled per 80 acres, 18 per cent for one well per 40 acre tract, 15 per cent when one well is drilled on 20 acres, 12 per cent where one well per 10 acres is drilled, 9 per cent for one well to five acres and but 7 per cent of the open flow capacity from wells drilled on smaller tracts. This act encourages wider spacing of wells.

At the present rate of production the life of the Monroe field is estimated at another 20 years. H. W. Bell in state Bulletin No. 12, has suggested that with a probable consumption of 328 million cubic feet per day during the next 10 years there will follow a period of declining production stretched over 38 years.

Something of the size of this field is shown by the accompanying map. The field is comprised of an area of 347.05 square miles divided into eight zones based upon rock pressure. Original rock pressure for the field was 1025 pounds which has decreased in varying proportions dependent, to a large extent, upon the number of producing wells in each zone. However, for the entire field, rock pressure has decreased from 1025 pounds to 784 pounds, which is a decrease in rock pressure of only 23.5 per cent in the first 11 years of its life. A total of 356 wells were producing at the time of preparation of the map, out of a total of 503 wells drilled. Of this number 95 were productive but closed in. Thirty-four wells were lost, due to cratering in gas sand, deep, and other tests junked, or blown out in san dand water. In the entire areo only eight dry holes had been drilled.



MAP SHOWING EXTENT OF MONROE GAS FIELD

Manufacturing Methods

Carbon black manufacturers have improved their methods of operation and bettered their efficiency during the past few years to the end that they now obtain about twice as much black in present plant practices as was formerly secured. Whereas early reports of the U. S. Geological Survey indicated a yield of a little better than one-half pound per thousand cubic feet, the present yield is maintained around 1.084 pounds from the same volume of gas.

The various companies operating in the field are giving more and more tudy to the technology of the process for the recovery of black and such research has been conducive to better efficiencies and more accurate control of the burning process. Ideal conditions for the deposition of the carbon are now known. These conditions are virtually the opposite from ideal conditions where gas combustion is relied upon for production of heat. It is found that draft, properly controlled and accurately regulated, is essential to efficiency, and while it was once popularly supposed that "the less air the better," it is now recognized that air in proper proportions is essential to production of black carbon. There are many shades of black carbon. Then, there is gray carbon, a hard substance of impaired color which is not classified as "carbon black." It is not generally known that carbon black can be produced in as many various

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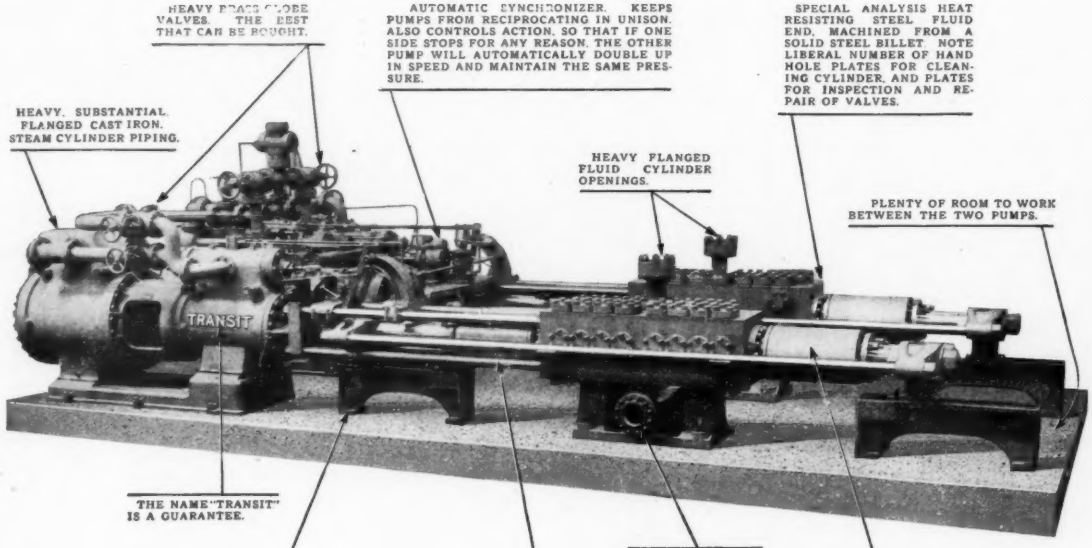
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shades or degrees of blackness as gasoline is white, for example. Texture and fineness are also of importance. Gray carbon occurs when heat is too high—therefore the control of temperature in the burning houses becomes of utmost importance. This being true, one of the most important factors in the manufacture of carbon becomes the weather, and wind. Rain effects the draft, effects the flame and cools the burner houses. Winds blowing across the burner houses in one direction produce a different result from winds blowing down between the long sheds or in the alleys, as they are called.

Operators rely upon their knowledge of flame luminosity for information regarding the condition of the draft and burner house. Thus, in the pat it was generally accepted that the darker the houses were when viewed through the peep holes, the better, while present operation practice calls for flame luminosity visible for considerable distances from the peep holes.

The process is one of thermal decomposition. The principal constituent of the Monroe gas is methane (CH^4). In the burner houses part of the gas is decomposed into free carbon and hydrogen. A portion is converted into methyl alcohol (CH^3OH) by oxidation. Part of this in turn is broken up into carbon monoxide and water (CO and H^2O) and a portion into formaldehyde, (CH^2O) which becomes oxidized further to become carbon dioxide and water, (CO^2 and H^2O). The methane must be partially oxidized for the creation of heat which aids in the thermal decomposition of the remainder into carbon and hydrogen, and the more accurate the control of this oxidation, then the greater is the production or the deposition of the carbon.

In the matter of draft one chemical engineer with a large producer of carbon black states that he has found that a draft through the burner houses equal to a vacuum of .05 inches of water gives excellent results under general operating conditions. The temperature favored between burner tips is about 550 F. Some difference of opinion exists as to spacing and type of burner tips in the field practices. A carbon dioxide content of the gases just above the flame of 3.5 to 4 per cent is favored by this engineer, as is a hydrogen content of .58 to 1 per cent, oxygen, 15.8 to 16 per cent, and carbon monoxide from .3 to .4 per cent. Recording devices showing the carbon dioxide content of the gases above the burner tips and the amount of draft are used to check the operation frequently.

The channel process remains by far the most important method of producing carbon black in the Monroe area. The channel plants are quite varied in the width, length and arrangement of channels since plant operators differ in their opinions as to what is the ideal arrangement. Width of channels vary from five to ten inches, with a width of seven to eight inches being the most common practice. Revolving cylinders are sometimes used as the collecting area, with other types of equipment in experimental use. During the first part of 1925 there was a total channel footage of 2,560,053, and a channel area of 1,542,268 square feet, in service in the Monroe field.

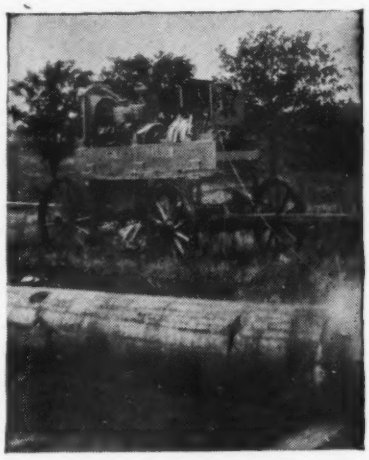
The foregoing discussion indicates that carbon black production is not just a matter of merely burning gas, but that the efficiency of the processes employed is dependent upon many and various influencing factors both mechanical and chemical—for the composition of gas from which "black" is manufactured is an item of much importance. Present research being conducted among the major producing companies indicates that the future will see still further advancing steps and improvements all pointing to higher recovery of black from a given volume of natural gas.

TABLE NO. 1

Metered and Estimated Production (Not Including Wastage) of Monroe Field (10 oz. Above 14.4 lb. Base)

Gas production, metered and estimated (not including wastage) of Monroe field, and Carbon Black production from 1916 to last of first half of year 1927.

Year	Metered Gas Produced M. cu. ft.	Estimated Gas Produced M. cu. ft.	Estimated Per Cent Prod. Over Metered Gas	Estimated Gas Burned Into Carbon Black M. cu. ft.	Carbon Black Produced Pounds	Approximate Extraction Pound 100 cu. ft.
1916	100,000?	100,000?	..	0	0	
1917	4,500,000?	4,500,000?	..	4,050,000?	2,835,000?	.700?
1918	6,093,000	6,093,000	..	5,650,000	3,960,000?	.700?
1919	20,291,000*	22,300,000	10	21,200,000	14,024,606*	.667
1920	18,100,000*	22,800,000	26	21,000,000	18,565,498*	.885
1921	31,034,000	41,000,000	32	37,700,000	31,003,615*	.823
1922	41,797,000	58,000,000	41	53,400,000	41,966,856*	.786
1923	86,582,000	130,000,000	50	120,000,000	101,398,881*	.845
1924	135,205,000	145,000,000	7	134,000,000	141,675,944	1.055
First half 1925	64,331,000	64,331,000	0	60,671,000	65,848,113	1.084
Last half 1925	.....	.....	..	.....	64,313,473	....
	.....	.....	..	.....	.....	0.921
1926	.....	.....	..	.....	129,564,840	...
First half 1927	.....	.....	..	.....	60,088,008	....
Total pounds carbon black produced to date					675,244,834	



Lincoln Stable Arc Welding Machine working on gas line.

Electric Welding on Gas Pipe Line in Louisiana

Houston—The first natural gas pipe line ever welded by the electric stable arc process is now being laid between Lamkin and Hodge, Louisiana. The line will carry gas from the Lamkin-Monroe field to the new plant of the Advance Bag and Paper Company at Hodge. This company, the main office of which is in Boston, owns the new gas line, and the large paper and bag manufacturing plant to which it leads is being built by the company at a cost of several million dollars.

The total length of the line will be 45 miles, and 35 miles of it are finished. The Big Three Welding & Equipment Company of Houston, Fort Worth, and Tulsa, is doing the welding.

Five Lincoln Stable Arc gasoline-driven electric welding machines are being used on the job.

Otto Kafka of Houston supplied the seven-inch Seamless Slip Joint pipe used in the line. This pipe is in 40-foot lengths with slip joints.

The welding has been facilitated on account of the slip joints, as they save the customary clamping and tacking. Another advantage which the bell joints are credited with is the expansion and contraction feature. On account of the extra metal on the curves of the joint, the line takes care of its own contraction and expansion.

When the weather is favorable and all five of the machines on the job are in use, about one-half mile of the line is welded per day, five men and a foreman being employed in the work.

The 35 miles of the line which has been completed has been tested with 650 pounds of gas pressure without finding any leaks.

Lamkin is about 75 miles east of Shreveport.

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We would like to stamp "MANZAI" on all of our regulators, but ten thousand years is a long time. Instead we will say that we hope to install this coming year for some one a regulator that will function as long and as successfullly as the one referred to above. "Good Luck" to all. Merry Christmas, and a Happy New Year.

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How Water-White Medicinal Oils Are Made

By H. L. KAUFFMAN

FIRST interest to any great extent on the part of American refiners in the manufacture of water-white medicinal oils was displayed about 10 to 15 years ago. During the period from 1913 to 1918 almost every large, complete refinery organization, with facilities for conducting research work, was striving to develop methods for making such water-white medicinal oils at a minimum expense. This experimental work has not ended even yet, however, and those companies who are now marketing these medicinal oils are continuously endeavoring to improve their manufacturing process.

For the benefit of the interested reader who is not thoroughly familiar with the operating procedure by which such medicinal oils are now being made, there is given in succeeding paragraphs a detailed description of how such oils are manufactured by the larger refiners.

That grade of water-white medicinal oil, which when finished, has a Saybolt Universal viscosity of 210 to 215 seconds at 100 degrees F. is made, most often, at one particular refinery from Peruvian crude distillate.

A narrow "cut" from the crude having a viscosity of 200 to 215 seconds at 100 degrees F. is first made. This fraction then, is charged to reducing stills where it is reduced to a "bottoms" (residual oil) having a viscosity of from 440 to 450 seconds at 100 degrees F.

Treating Proportions

The reduced medicinal oil stock (440-450/100 degrees F.) is next pumped to the conventional type of lubricating oil agitators, wherein the oil is treated in five dumps with a total of 37 per cent by volume of sulphuric acid. The acid is applied to the oil in the following proportions:

First treatment—8 per cent by volume.
Second treatment—8 per cent by volume.
Third treatment—7 per cent by volume.
Fourth treatment—7 per cent by volume.
Fifth treatment—7 per cent by volume.

Particular attention is called to the fact that the oil is cooled to a temperature of 60 degrees F. after each acid treatment; that is, after all the sludge has settled and has been drawn off from the bottom of the agitator. Cooling is accomplished by circulating the oil following each acid treatment, except the last, through a chilling machine of the type ordinarily used in wax plants, wherein the oil is colled by the circulation of cold brine.

After the last treatment with fuming sulphuric acid, the next step is the neutralization of the oil. This is done by the addition of such quantities of a 20 degree Be. caustic soda solution as may be necessary for the removal from the oil of all traces of acidity, then agitating, drawing off the waste alkali and thereafter allowing the oil to stand in the agitator until a sample drawn from the bottom is fairly clear.

The neutralized oil is then transferred again to the lubricating stills where all the oil is removed as an overhead distillate, with the exception of about four per cent, which amount is allowed to remain in the still as a residual product.

The overhead distillate is now returned once more to the stills where it is steamed "sweet". During this process of sweetening with the aid of steam, the oil is raised to a temperature of about 450 degrees to 500 degrees F.

Pressing

The next step followed by this refiner in the manufacture of water-white medicinal oils is to press the sweetened oil. In this connection it might be mentioned that no preliminary cooling is given the unpressed oil. From the storage tanks this oil, at a temperature of 70 to 80 degrees F., is pumped directly to chillers (Carbondale type) in which the oil is chilled to a temperature of from 16 to 18 degrees F. below zero.

The solid paraffin wax that has separated out from the oil during the chilling process is now removed by passing the cold oil through wax filter presses (Carbondale type).

Data relative to the yields of pressed oil obtained during the pressing operation are shown below:

Barrels of oil chilled, per chiller, per 24 hours—100, 50-Gallon barrels.
Barrels of oil pressed, per press, per 24 hours—50 to 55, 50-Gallon barrels.
Barrels of oil pressed, per ton of refrigeration—6 to 7 50-Gallon barrels.
Barrels of oil put through presses before taking down press for cleaning—400 to 500, 50-Gallon barrels.

The wax filter presses are cleaned by pulling back the head and running a perforated pipe through the center into which steam then is turned.

The mushy wax left in the presses is steamed out, following the manner mentioned above, and thereafter is mixed with the foots oil resulting from the refinery processing of other grades of lubricating oil.

The pressed medicinal oil stock has a cold test of from plus 8 degrees to plus 10 degrees F.

The pressed oil is next transferred to the agitators for a final treatment with fuming sulphuric acid. At this time the oil is treated with a total of 15 per cent by volume of fuming acid, which is applied in two dumps: first, 8 per cent by volume and, lastly, 7 per cent. The oil is cooled to 60 degrees F., following the first acid treatment, by circulating through chilling machines as previously described, before applying the second and last dump of fuming acid.

When all the sludge has settled completely and has been drawn off, the oil is blown with air in the acid agitators until as much as possible of the caid fumes have been removed therefrom. The oil is not neutralized at this stage of the process of manufacture.

From the agitators the oil is transferred to the stills where it is reduced to the proper viscosity and steamed sweet, when necessary making use of the distillation and steaming procedure as previously described.

Filtering

The last step is to filter the oil to remove final traces of impurities and for an additional improvement in color. Filtering is accomplished by percolating the oil through a column of coarse-mesh fullers earth, following the conventional manner employed in the percolation filtration of other grades of lubricating oils. When the oil issuing from the bottom of the filter goes "off-test", the stream is diverted to another tank.

From the filter plant's storage tanks, the finished water-white medicinal oil is pumped to tanks that supply the "Medicinal Oil Manufacturing Department," in one of the buildings of which department the finished oil is bottled and made ready for shipment.

The refiner whose method of making the 210 to 215/100 degrees F., water-white medicinal oil has just been described also markets another grade of medicinal oil having a Saybolt Universal viscosity of 150 to 150 seconds at 100 degrees F. Although at one time this grade of oil also was made from Peruvian crude, it is now made usually from an American asphaltic-base crude oil. A cut on the crude is made so as to obtain a 160/100 viscosity lubricating distillate, which is then returned to the stills and reduced to a bottom having a viscosity of 240 degrees at 100 degrees F. Thereafter, the method of processing is the same as that described for making the 215 viscosity medicinal oil, with the exception that 18 per cent instead of 15 per cent by volume of fuming sulphuric acid is used on the second acid treatment. This grade of water-white medicinal oil is usually shipped by this refiner in drums or cans instead of being bottled.

Another refiner makes his particular brand of medicinal oil by first mixing to-

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gether 50 per cent each of pressed "37-degree" distillate and ice machine oil, which mixture is then placed in a still and reduced to a residual oil bottoms having a viscosity of 120 seconds at 100 degrees F.

The reduced oil is then pumped to a lubricating oil batch agitator where it is treated, in several dumps, with a total of 20 per cent by volume of fuming sulphuric acid.

Neutralizing

Having drawn off all the sludge, the oil is now neturalized by adding as much caustic soda solution (10°-15° Be.) as is necessary to remove all traces of acidity. The alkaline solution is then drawn off and, without washing (washing with water causes emulsification of the oil), the neutrilzed oil is pumped back to the stills.

At the stills a "cut" is made from 75/100 viscosity at the worm to 105-110/100 viscosity at the tank. Usually, distilling to a 5-7 per cent bottoms gives the desired viscosity on the tank. This cut is now brought back to the stills and steamed sweet. Steaming for from two to three days at about 400 degrees F. is usually necessary in order to obtain satisfactory results.

The sweetened oil is next pumped to the agitators and again treated in several dumps with a total of 20 per cent by volume of fuming sulphuric acid. The oil is not neutralized with any alkali, the excess acid fumes, etc., being removed for the most part merely by blowing with air.

From the agitators the treated oil is pumped to the filter house, where it is filtered through fullers earth, after which it is ready to be bottled .

One Patent

E. B. Cobb describes a method for making water-white medicinal oils patented by him (Patent No. 1,387,835, issued August 16, 1921, application filed April 28, 1920) and assigned to the Standard Oil Company of New Jersey, in the specifications of afore-mentioned letters patent, as follows:

"A petroleum distillate fraction having a gravity heavier than 28 degrees Be. and a viscosity of about 215 at 100 degrees F. (Saybolt) is subjected to successive treatment with about 5 per cent by volume of 66 degrees Be. sulphuric acid and with 30-35 per cent by volume of fuming sulphuric acid (20 per cent anhydrid), the treatment with fuming acid being effected in several dumps, say, three or four, with approximately equal proportions of the fuming acid, the oil being cooled between dumps. After the treatment with 66 degrees Be. acid and after each dump of the fuming acid treatment the acid sludge may be permitted to settle from the oil and is separated therefrom, carrying with it considerable proportions of the sulfonated compounds produced from the oil. The acid-treated oil still contains oil-soluble sulfonated compounds. The oil is then treated in an agitator with about sufficient caustic soda solution of 10 to 16 degrees Be., or other alkali solution, to somewhat more than neutralize the acid, say 10 per cent, allowed to settle, and the spent caustic solution removed. The neutralized oil, which may be blown bright in the agitator, if desired, has a volume about 60 per cent of the original oil treated. The sulfonated compounds of the oil are, by the neutralization process, converted into soaps, which are largely soluble in the oil.

"The treated oil containing the oil-soluble soaps of the sulfonated compounds is next charged into a still, where it is subjected to steam distillation until approximately 95 per cent has been distilled off and collected, a temperature below the cracking point of the oil, say 600 degrees F. or thereabouts, being maintained. The remaining five per cent of residue contains substantially all of the sulfo-compounds originally present in the oil. The distillate obtained, however, may contain hydrogen sulfid, free sulphur, or compounds which will develop sulphur odors or tastes in the oil. In order to remove these sulphur-containing substances from the oil, the oil may be charged into a still, treated to, say, 400 degrees F. and treated with steam. It may be steamed for from 2 to 4 hours (after having been heated up), the sulphur and sulphur compounds being thereby eliminated and the viscosity and flash point of the oil brought to the desired figure. The oil may then be steamed until it has a viscosity of 220 to 230 seconds at 100 degrees F.

"After the treated oil has been steamed, it is again treated with fuming sulfuric acid in less quantity than that used in the first treatment. For example, two dumps of 7½ per cent of fuming acid each may be utilized, the sludge being separated from the oil after each dump. The effect of this acid treatment is likewise to produce sulfonated compounds, some of which are soluble in the acid and settle out with the sludge, while others remain in the oil. The oil is then slightly over-neutralized by agitation with, say, five per cent by volume of 10-15 degrees Be. caustic soda solution, the mixture allowed to settle and the spent soda solution drawn off. The oil-soluble sulfonated compounds are converted by this process into soap, which remain in solution in the oil. These sulfonated compounds are objectionable, not only for the reason that they tend to produce emulsions when mixed with water, but also for the reason that they interfere seriously with the filtration of the oil, a matter of importance particularly in the case of the production of medicinal oils. After the removal of the spent caustic soda solution, the oil is treated with isopropyl alcohol, preferably utilizing an aqueous solution containing, for example, 70 per cent by volume of iso-propyl alcohol having a specific gravity of 0.81 and 30 per cent of water. About five per cent by volume of the iso-propyl alcohol solution is thoroughly agitated with the oil, and the whole is then allowed to settle. The alcohol solution which settles to the bottom contains the sulfonated compounds, which are removed with it. Some of the alcohol remains in the oil. This may be recovered by heating the oil to 300 to 350 degrees F., thereby vaporizing the alcohol and condensing it, or by blowing the oil with steam at about this temperature. After treatment of the oil in this manner it may be filtered through fullers earth or a like filtering medium."

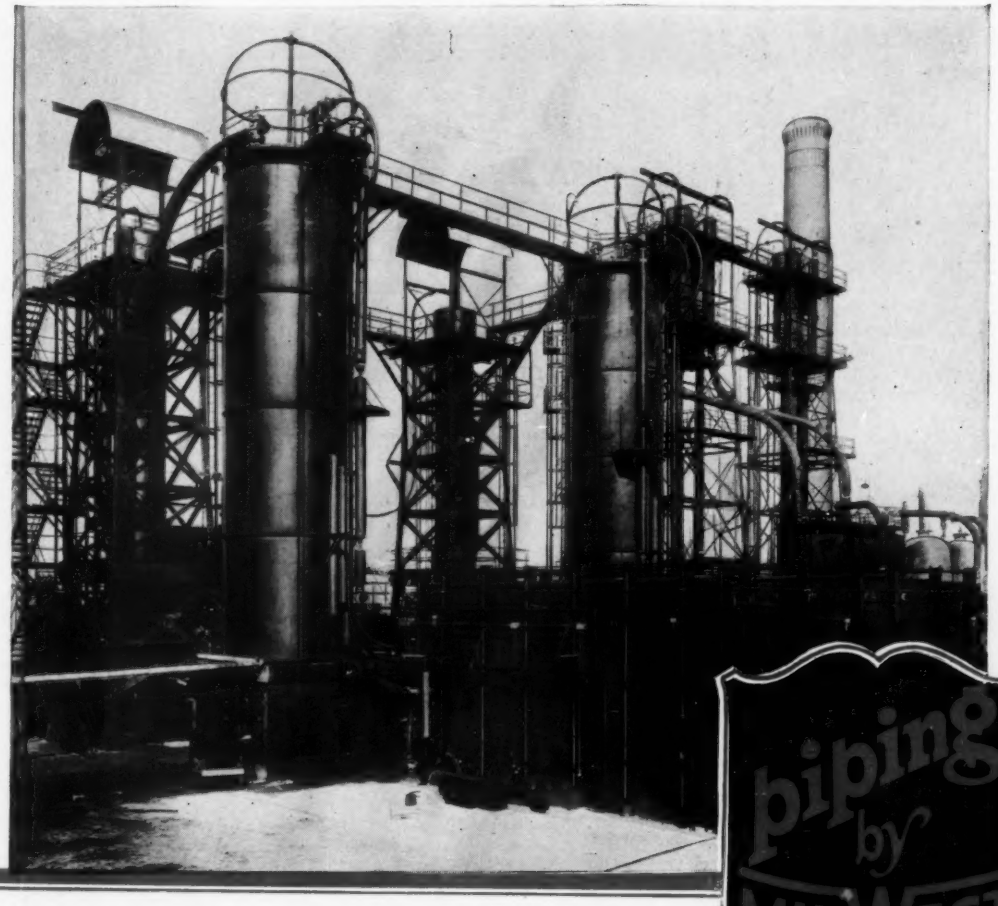
Washing

From the foregoing description it will be noted that washing the treating oil with an aqueous solution of iso-propyl alcohol constitutes an essential step wherein the procedure is different from the medicinal oil manufacturing proceesses previously described.

Letters Patent No. 1,315,623 issued to E. B. Cobb on September 9, 1919, on an application filed August 2, 1917, and by said Cobb assigned to the Standard Oil Company of New Jersey, describes a process of treating petroleum oils (making water-white medicinal oils), which consists in subjecting the oil to strong sulphuric acid in proportion of about 37 per cent by volume of the oil treated, then treating the oil with alkali of from 10 degrees to 40 degrees Beaume in amount of about 20 per cent of the body of oil being treated, thereby producing a clear line of separating between the oil and the aqueous layer upon settling, separating the oil from said aqueous alyer, dehydrating the separated oil and *removing the impurities resulting from the acid and alkali treatment by subjecting the oil to the solvent action of glycerine, which is practically water-free and in amount of from about 5 per cent to about 10 per cent by volume of the body of oil.*

Letters Patent No. 1,388,517, also issued to E. B. Cobb, August 23, 1921, on an application filed July 23, 1914, and by said Cobb assigned to the Standard Oil Company of New Jersey "covers" the process of making a decolorized hydrocarbon oil (water-white medicinal oil) of viscous character, consisting in (1) subjecting stock which has a viscosity above 40 seconds at 100 degrees F. to the action of sulfuric acid so as to form an acid sludge which is removed; (2) distilling the acid-treated oil with use of special agency to prevent the decomposition of component hydrocarbons and so obtaining distillate which has a viscosity above 40 seconds at 100 degrees F.; (3) subjecting said distillate to the action of sulfuric acid so as to form an acid sludge which is removed; and (4) filtering the oil which has thus been twice subjected to sulfuric acid and to an intervening distillation through solid decolorizing material, sufficiently energetic treatments with sulfuric acid being employed for the decolorized oil to be obtained with a proportion of solid decolorizing material equivalent in decolorizing power to not more than about 300 pounds of fresh Florida clay per barrel of oil subjected to the filtering operation and the total sulfuric acid being equivalent in content of sulphur trioxid to not more than about 20 gallons of 20 per cent fuming sulfuric acid per barrel of stock in the case of an oil of about 80 seconds viscosity at 100 degrees F. and with corresponding increase of the solid decolorizing material and the sulfuric acid respectively in the case of more viscous oil.

Two other patents issued to E. B. Cobb on February 1, 1927, on applications filed April 8, 1922, also relate to the manufacture of water-white oils. These



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Safety and Fire Prevention in Natural Gasoline Plants*

By GEO. F. PRUSSING,
Chairman Petroleum Section, National Safety Council

JERRY SHEA, who was to have prepared and presented this paper, followed H. C. Miller as safety engineer of the Bureau of Mines, assigned to the petroleum industry on the Coast. For the past several months he has been studying the very problem represented by the title of this paper and since he has been inopportunely called East, we shall have to look forward to his official report to discover what he has learned of the hazards of this fast growing part of the oil business. As a last minute substitute for Mr. Shea, I can bring you little that is based on a minute study of your own unique hazards, backed by statistics of California accidents. Rather, I will give you, if I may, the story of how the petroleum industry has met this same problem in other departments and let you apply the lesson to your own peculiar hazards.

There is something very suggestive about the title of this paper and perhaps nowhere in the oil industry does it so accurately hit the mark. Especially when viewing the short history of the natural gas-gasoline industry in California, is the fact borne in upon one that in that industry safety is fire prevention. Read the keen analyses of fatal accidents in the California petroleum industry made each year by H. C. Miller of the United States Bureau of Mines and you will discover that the refining of crude oil has become so safe that during 1926 there were no fatal accidents that were pertinent to the actual refining of oil. This marked control over a really hazardous business is made even more striking when the fatalities at natural gas-gasoline plants are reviewed. Not only is the ratio of deaths to men employed exceedingly high, but in almost every case the cause of these deaths has been fire.

Starts With Study

Safety in any branch of the oil business starts with the study of experience, goes next through a phase of engineering revision and ends in the education of personnel in safe practices. Perhaps "ends" is the wrong word, for the education of personnel never ends, if it is to be successful. We cannot, however, undertake either engineering revision or education until we know what is causing our accidents, how serious these are and how much they are costing us and our men. The first step is, therefore, the very prosaic one of getting prompt, accurate account of every accident that requires first aid or medical care or that causes a man to lose time from his regular duties. The simplest means to that end is to insist that the provisions of the Industrial Accident Commission are strictly complied with, for in California such accidents as I have defined must be reported. Have these reports made somebody's business, so that they are properly made out, promptly sent to headquarters and there analyzed and called to the attention of the man in charge of operations.

Every accident that so disables a man that he must leave his work, either for medical care or because he is incapacitated, should be investigated by someone competent to get at first causes. Of all the silly fiction with which this age is cursed, the worst is by all means the usual accident report. "Burned face while lighting boiler," says the report. "Few days" for estimated disability. An honest investigation reveals the following facts:

The gas burner had no pilot light. The plant operator had hired a fireman on the latter's statement that he knew all about firing boilers, having rough-necked on a drilling rig. Having pinched the fire down to nearly nothing, a gust of wind had struck the unprotected setting and had blown out the flame. With hand on gas valve, the fireman had peered in to see if the fire had really gone out or was merely hiding out somewhere in the firebox. The explosion which burned his face also wrecked the boiler setting. Even the "few days" disability proved to be an optimist's dream, lengthening into 12 weeks, costing the man the use of one eye and his company a medical and compensation bill of nearly $4000. There we have a picture of a plant needing engineering revision along definite lines, an organization in need of overhauling, especially in the hiring and training of men and discipline in the enforcement of the most elementary items of safe operation.

Each In His Own Language

Interest in the moving force of success and to create interest we appeal to each man in the language he best understands. Selfishness is an unkind term and so we call it enlightened self-interest, when we tell the management that certain items in the budget are for the purpose of preventing accidents. For accidents are pure waste, costly in man power, in material, in good hard cash paid out for doctors' bills and in unnecessary suffering. Having, therefore, set up the machinery for getting to the man in charge of operations each day the real story of how accidents occur, it is no more difficult to get the funds to cure them than it is to overcome any other error in operating technique. If our management is frequently enough hit in the eye with the cold fact that practically all gas plant accidents are preventable, the word will soon go down the line that accidents must stop.

What can we truthfully say as to the cost of accidents? Just this, that there is no single item of waste in modern industry in which the cost is so high. Whether we pay the toll to an insurance company or absorb it as part of the operating expense, even the direct money cost of caring for the injured is a tremendous burden. Consider this other fact, no less true, though seldom mentioned. For every dollar spent for compensation and medical care of the industrially injured, not less than four dollars are spent in incidental costs. The wrecked boiler setting, the training of a new man, the lost time of fellow workmen, the added supervision of foremen, the upset of morale, these are items which can all be translated into dollars drawn from the profit side of our operations and to what end? When pounding sand down the proverbial rat-hole is classed among gainful occupations, then and not till then can management afford to become complacent about the money cost of industrial accidents.

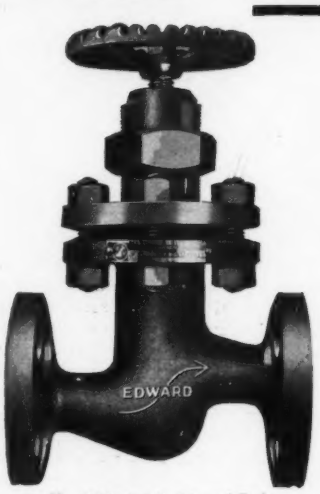
Accidents Are Bad Business

In this connection it may not be amiss to mention that management has already seen this point. Not in every company, it is true, but in the larger more farsighted organizations and also in certain departments such as your own, headed by clear-thinking technical men, accidents have been outlawed as evidence of bad business. We see that fact constantly in the statistics reported to the National Safety Council and to the United States Bureau of Mines. Miller shows a constant decline in the fatal accidents among the drilling and producing personnel of the California companies. In 1922 there were 24 fatalities for every hundred million barrels produced; in 1926 the figure was but 11. Had the 1922 rate prevailed during 1923-4-5 and 6, 131 men would had lost their lives, who now are living. Translate that number of lives into dollars by whatever formula we will, it represents the profit due to safety. I have seen many of the results of fatal accidents in this business of ours, but no poor devil laid out in death nor heartbroken widow and fatherless children have ever been so eloquent as is the picture of these 131 men, that safety pays and that management knows and cares.

If I have presumed to suggest that you sell safety to your management by showing them the real cause of accidents, you must pardon it as something of an ob-

*Read before the fall meeting of the California National Gasoline Association, November 16, 1927.

—for Forged Steel Valves?



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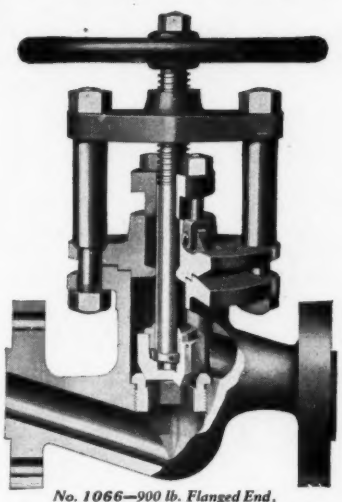

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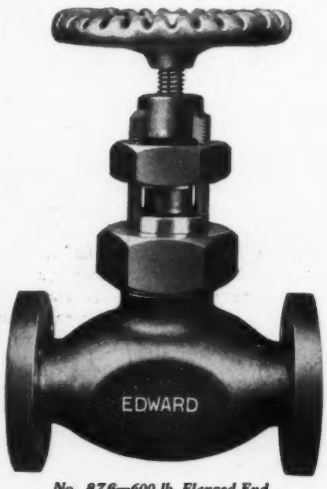

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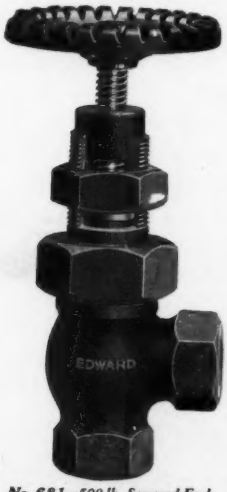
No. 682—500 lb. Screwed End, Union Bonnet Globe Valve



No. 681—500 lb. Screwed End, Union Bonnet Angle Valve

No. 680G—500 lb. Screwed End, Flanged Bonnet, O. S. & Y. Globe Valve

session that has come from hard and painful experience and the observation of others who have been far more successful in their efforts. Only from management can come the dollars that make possible the use of proper materials, the costly guards about machinery, the even more costly time for planning plant design properly instead of gambling. The head of the most successful contracting firm in this city told us that their profit comes from painstaking planning of every operation on paper. I know that in the gas industry changes in operating technique must first pass the bright boys with the sharp pencils, the slip sticks and the calculating machines. Just so, the real true cost of change taking can be tried out and weighed for the benefit of those who hold the purse strings. You can tell your people to a split mill what will be the dollars and cents profit of an added intercooler, an extra stage of compression and the return of gas down to a five spot. But have you ever figured the cost of a broken cast iron fitting under a pressure storage tank with your boilers only a hundred feet away? Have you assured yourself that nowhere, with the break of a fitting, will that flood of gaseous dynamite find the spark to turn it into a hell of fire? Not until you have made as sure as engineering skill permits that your plants are proof against that fortuitous union of fuel and fire, can you justify your positions as the custodians of lives and property.

Human Element

It may well be said that review of the accident records of our industry show but a small proportion due to mechanical failures. And true it is that perhaps 20 per cent of the number are mechanical and 80 per cent human in their ultimate cause. It is this very fact, however, that throws the emphasis on guarding the mechanism. When the man fails the unguarded machine takes its toll. My first experience in accident investigation taught me why machinery must be guarded. A temporary pumping plant had been built in a tank farm. A rotary pump was driven by a large horizontal gas engine set on wooden bolsters, with pits dug for the flywheels. The plant was housed in a rough lumber shack. The plant ran day and night, attended by three tour men whose principal occupations were oiling the engine and trying to sleep in spite of the bark of the exhaust. On the day of the accident, the pumper coming on tour tripped on the threshold and dived head-on into the unguarded flywheel of the gas engine.

Had there been a toe board about the flywheel pit, that man might have saved himself. The marks on the ground showed how hard he had tried to regain his balance, during that instant that death stared him in the face. Had there been only a rail, he might have grasped it. But there was nothing—just a temporary plant—not worth spending money on. Yet I am sure that engine had a governor, an oiling system and a fuel supply. The man who installed it—and I mean the superintendent, not the mechanic—had judged the importance of these parts correctly enough, but he measured human safety in terms of the machine, not the men who ran it.

The safest criterion for judging how well to guard machinery is good horse sense. Remembering that machinery accidents, if few, are always serious, the guard that prevents contact with moving parts is always best. The normal operations that a man must perform can usually be done more efficiently when the chance of being caught has been removed. Even oiling devices can be rearranged to make them accessible. The average engine designer thinks that the man who oils has wings and flits from oil cup to oil cup over flywheels, cranks and cams. Automobile designers once had a similar notion, though what bird or insect could find the clutch throwout yoke grease cup on a Buick, I know not. The errors and omissions of designers are legion. Try to buy a machine that complies with the law. I know one manufacturer who writes his own specifications for machinery and includes his own ideas on safeguards, handy-oiling devices and adjusting mechanism. We can not all go so far, but we need not operate a machine until it is right, legally and safely guarded.

Recent Example

We read yesterday of the terrible disaster in Pittsburgh. I can see you all

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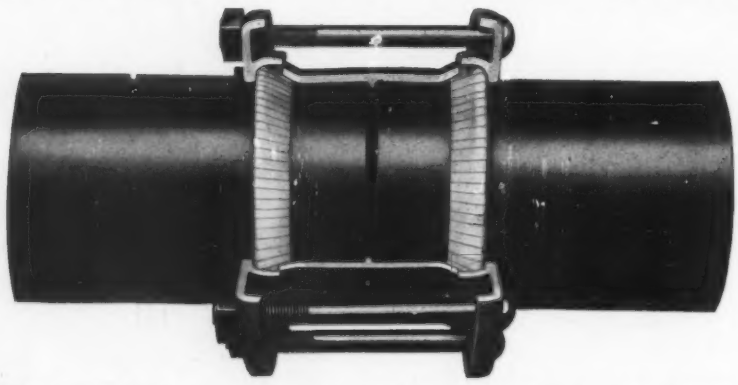
for Dresser and Dayton Joints



"John Crane" armored gaskets have been developed with the idea of overcoming the shortcomings of asbestos gaskets. They permit easy expansion and contraction. They are flexible, compressible and quickly installed. Armor of copper, aluminum foil prevents asbestos core from disintegrating.

They do not stick or vulcanize to the pipe. They resist acid, seal perfectly and can be used over and over, effecting a genuine worth-while economy. Suitable for high temperature exhaust joint service.

18 months service on exhaust joints, have been recorded.

Inquiry invited.

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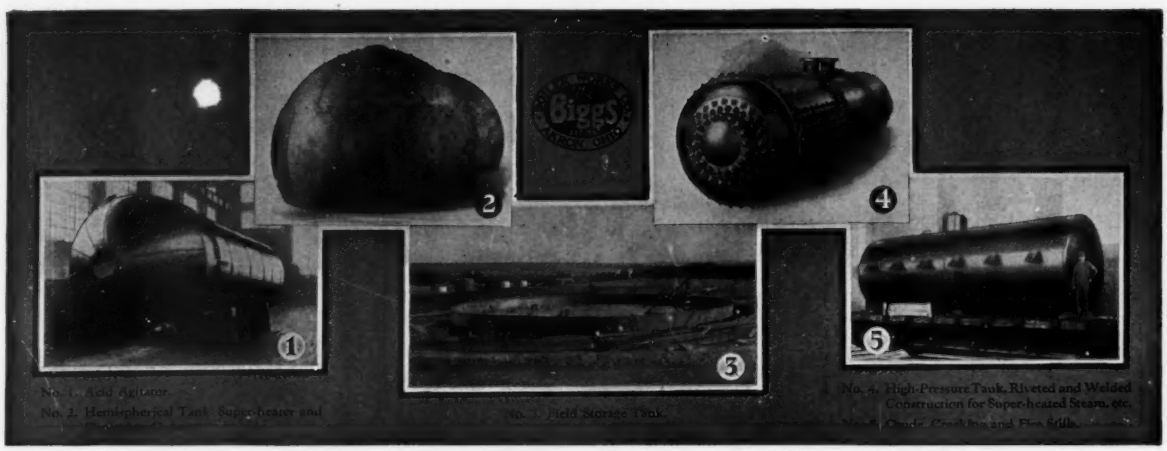

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"In conservation, as I see it, there is no hazarding the future safety of the nation for any mere present day advantage, nor, on the other hand, should we suffer any utter sacrifice of the present in favor of the future.

"There can be and should be a rational balancing of present and future advantages.

"In all respects conservation makes its appeal to reason and is a policy that should win the support of men of affairs. It is a practical policy in the nation's business."

Extract from the speech of Hon. Hubert Work Secretary of the Interior and Chairman of the Federal Oil Conservation Board, before the Mineral Law Section, American Bar Association, at Buffalo, August 30, 1927

Universal Oil Products Company
Owners of the Dubbs Process
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skimming as I did through the graphic news accounts, seeking the few lines of technical explanation that would make the cause of the explosion clear. If you found it, as I did, and if it is correct, that accident will have to be charged against utter disregard of the most elementary safety measures. Think of that huge holder with a capacity of five million cubic, left over night connected to the pipe system, after having been blown free of gas. Think of sending men into such a holder with open torches without testing the atmosphere for gas! Do not think I am condemning anyone, for such is not my purpose, not knowing all the facts.

But here we have a tremendously spectacular example of what in a smaller measure we are daily trying to prevent. You who know gas and oil valves know how little trust can be placed in them after they have been in service for some time. I have read and seen applied some of the rules which you men enforce before you permit a man to enter even the smallest tank or other space where flammable vapors might accumulate. Let me quote from such a set of rules:

"No repair work involving fire or spark producing tools shall be undertaken in any tank or other space subject to gas accumulation until said tank or space shall have been freed of all oil and gas and a certificate to that effect shall have been obtained from a competent chemist.

"No such work shall be undertaken until all lines leading to such tank or space shall have been disconnected or slip blanked. An electrical bond shall be made about each point where a line is to be broken."

If that seems far fetched, remember what happened under the dock at Wilmington a year ago. The ordinary routine steps were taken to free a line of gas before welding was done in a confined space but the one step that might have saved half a dozen men from disaster was omitted. No one apparently made sure that these ordinary precautions had been successful before the torch was applied. They gambled and lost.

In a recent refinery fire some valuable lessons were learned about our fire fighting technique. Briefly, we learned that fighting one mean fire is worth a hundred of the usual perfunctory fire drills. We have as a result for four months been experimenting with a new idea, new at least to us. We have been holding in our refineries and at our gas plants what we call problem fire drills. Their purpose is three-fold. We hope to be able to teach our men how to prevent fires by making them fight imaginary fires that might happen anywhere through carelessness or mechanical failure. We hope to make them think out what they would do under such circumstances *now* under the friendly, if critical, eyes of their superiors, rather than waiting for a time when thought might be impossible. But even more important, we hope to habituate them to go calmly through the technique that may some day save their lives.

Example of Problem Fire Drill Report

Problem—A gasket on top of one of the absorbers blew out and an explosion followed with the entire absorption plant in flames. The absorption plant operator was badly burned.

Execution—The firemen blew the fire whistle and met the compressor plant operator at the fire house. They put the absorption plant operator in the fireman's machine after rendering first aid. The fireman then left with the operator for the emergency hospital. The compressor plant operator then shut the compressor plant down and shut the gas off from the field. He then went to the Rose No. 3 boiler plant and shut it down, closing the main steam header. From here he went to the main boiler plant and shut it down also closing the main steam header valves. He then went to the office and, breaking in, telephoned the operator, who in turn notified the foreman. As soon as help arrived he attached the fire hose to protect the boiler house and used the 40-gallon Foamite to protect the compressor plant.

Results—Due to the valve arrangement on the gas lines to and from absorption plant in case of a major fire in the absorption plant, it could not be bipassed and and a complete shotdown of the field would be necessary. It also shows that with only three operators on duty at night in case of a fire of this kind all men should be familiar with the operation of the other units.

Men Are Learning

Already we can say that in a large measure these hopes are being realized. The men are learning the emergency handling of oprating equipment as well as fire equipment. They are taking an interest that speaks well for the security of the plants they operate.

I would fail in my duty if I did not mention here the greatest single help that any man in this business who is interested in safety has always at his elbow. The National Safety Council is an organization of men who are interested in saving lives and property and who realize that we cannot any one of us think of everything. We are, therefore, banded together for the sole purpose of exchanging ideas, learning from the other's mistakes and taking freely the ideas which he has found useful. Four thousand employers with payrolls aggregating eight million men and women, make up that vast family. In it our petroleum section is one of the most active, numbering more than one hundred of the leading oil companies. Here on the Coast the petroleum section is in charge of Mr. Scofield of the Associated Oil Company with Mr. Eggleston of the Pan-American, Mr. Donovan of the Standard, Mr. Lynch of the General Petroleum, Mr. Wolfin of the Calpet and Mr. Anderson of the Richfield making up our local executive group. The Council is termed legally a non-profit organization. Let me say that it is a misnomer, for the profit that comes from working with men like than on safety and fire prevention is very real and very great. One man cannot think of everything, but a lot of men all working toward the same end can do wonders.

Atlantic Starts Work on Line to Winkler County

Dallas, Texas—The stringing of pipe was started last week on the Atlantic Oil Producing Company's 71-mile ten-inch welded crude line extending from the Hendricks field, Winkler County, to tank farm near Midland, and the completion date is set for the latter part of January. Janes Contracting Company, 805 Trunk Street, Dallas, received the contract for the welding of the line, and Dunn Brothers have the teaming contract.

Atlantic is using 51 miles of double length joints of pipe to speed up construction, and the remaining 20 miles will be single length joints. The field pump station will be located at Atlantic's Hendricks field tank farm in the southeast quarter of section 31, block B-5, and an intermediate pump station will be built near the halfway point. The line will terminate in section 40, block 38, T. & P. Ry. survey, township 1-S, Midland County, where three 55,000-barrel and 12 80,000-barrel tanks are under construction. Atlantic has five 80's scheduled for the Hendricks field tank farm, with additions planned. This stub pipe line will enable Atlantic to turn West Texas crude over to Magnolia Pipe Line Company at the Midland farm for delivery to the Gulf Coast, or make use of tank cars in moving the oil to tidewater. Magnolia has contracted to handle 10,000 barrels of West Texas crude daily for Atlantic, but a portion of this will come from Atlantic's properties in the Church and Fields area, Crane County.

Motor driven centrifugal pumps will be used by Atlantic in each of the main line stations, and foundations for the stations have been started.

Erecting Plant

Dallas, Texas.—The Blue Bonnett Oil & Refining Company, with headquarters at 1009 Santa Fe Building, is erecting a 3000 barrels daily capacity topping plant at Wickett, Texas, located on the Texas & Pacific railroad in West Texas. The crude supply for this plant has been contracted for from the Southern Crude Oil Purchasing Company for a period of one year, and deliveries are to be made by Southern's line extending from the Hendricks field to Wickett. The refining concern has obtained a large fuel oil order from a railroad, and will confine its operations to the making of fuel oil from this 30 degree gravity crude, selling the "tops" to other refiners. A part of the equipment used in the Wickett plant formerly saw service in the Elliott Jones skimming and cracking plant at San Antonio. The cracking units in the former plant were purchased by the Lion Oil & Refining Company, El Dorado, Arkansas. The officers of the Blue Bonnett Oil & Refining Company are: John T. Withers, Jr., president; B. L. Woolley, secretary-treasurer; and I. B. Chittenden, plant superintendent.

FOXBORO AUTOMATIC FLOW CONTROLLER

Don't Blame the Pumps!

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What you need is a Foxboro Automatic Flow Controller.
This instrument holds the flow to the stills at a constant, fixed rate. The operation of this instrument is simple, positive, automatic. It eliminates the greatest variable in the refinery. It puts the finishing touch on process balance.

A Foxboro Automatic Flow Controller together with a Foxboro Automatic Temperature Controller makes still operation automatic. Closer cut fractions result. The chief cause for reruns no longer exists.

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Determination of Vapor Tension of Volatile Liquids

(*Continued from page* 50)

us consider the Engler distillation of such material. You have probably observed that the greater portion of material, which shows up as loss, comes off at the first part of the distillation, and as the distillation progresses the material vaporized becomes heavier. Now if we were to collect the vapors from the distillation and make a continuous vapor pressure test as the distillation progressed, we would find that the vapor pressure would rapidly decrease. The first vapor pressure would be on the very lightest fractions and would be very high and as the vapors became heavier the pressure would lower. In a similar manner, if the liquid was contained in a cylinder held at constant temperature and a movable piston was fitted to one end, the other end being closed, we could get a vaporization of the liquid by pulling out the piston and increasing the vapor space above the liquid, at the same time holding the temperature constant. It can readily be seen that, by increasing the vapor space, at some point all of the lightest material will be vaporized from the liquid and as soon as that point has been approached the vapor pressure will start to decrease.

Now if we fill the bomb with gasoline of this nature and draw the liquid down to the A mark, it is possible that at this point all of the very light material (say a small percentage of propane) may be vaporized. Now when the liquid is drawn to the B mark, the character of the vapor will be changed and the vapor pressure will be much lower. In this particular case the pressure exerted by the light fraction would be only one-half as much at "B" as it was at "A." To prove this point the vapor pressure bomb was completely filled and then drawn down to various marks at constant temperature. The pressure was noted. Under these conditions the air dilution was a minimum amount.

Liquid Level	Press. Lbs. Abs. @ 70° F.
Above A mark	39.5
A mark	39.4
Half between A and B mark	37.8
B mark	36.5
Below B mark	36.0

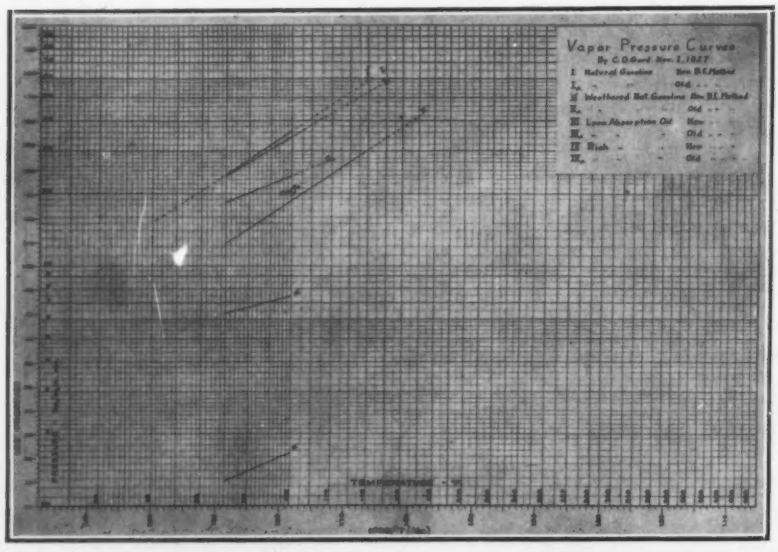
Thus it is shown that the true vapor pressure cannot be obtained in this manner. However, the narrower the boiler range of the material tested the closer the vapor pressure indicated by the bomb will be to the true vapor pressure.

Obtaining Correction Factor

By the use of a mercury U gauge and small bore tubing with special fittings at the top connection on the bomb, thus reducing the air space to a minimum, it may be possible to obtain a correction factor to apply for the error due to the small amount of oil present above the liquid. This may be accomplished with running several vapor pressures on a pure liquid by purging the bomb and then completely filling it in an ice-salt bath and computing the error due to air. The liquid would be drawn down only a sufficient amount to give a vapor space. By making several tests in this manner the error in natural gasoline vapor pressures might be obtained and a correction chart made. Further study might be made to determine just how much liquid could be withdrawn before actually lowering the vapor pressure.

Sufficient work has already been done to give relative values on the old and new B. E. methods of taking vapor pressures. A wide range of material was selected for these tests. The results are shown on the curve sheet. Curve I represents vapor pressures taken on a natural gasoline by the new method and curve IA vapor pressures on the same kind of gasoline by the old method. It will be noticed that the two curves are relatively close, but that the new method gives vapor pressures of a higher value. Curves II and IIA are for a weathered gasoline and here it will be seen that the old method gives a higher vapor pressure. Curves III and IIIA are for lean absorption oil and show similar results, but to a greater degree. Curves IV and IVA are for rich absorption oil, showing how light material effects the relative pressures obtained by the two methods.

Indications are that where light material is present in large quantities the two methods will give similar results, but where the material tested is heavy the presence of air in the bomb used in the old method will give a much higher vapor pressure.



VAPOR PRESSURE CURVES

Navy Asking Bids for Natural Gasoline

Washington, D. C.—Proposals for the purchase from the Navy of royalty casing head gasoline produced on Naval Reserve No. 1, in California, will be opened at the office of the Inspector of Naval Petroleum Reserves, Los Angeles, December 15, it has been announced by the Navy Department. The contract will run for a period of six months from January 1, next. No definite amount of gasoline which will be available during the period can be given, but for the five months ended with last September the production averaged approximately 7500 gallons a month. The gasoline offered is from lands leased to the Pan-American Petroleum Company.

Start Four-Inch Line to Hendricks Field

Fort Worth, Texas.—The Ocean Oil and Pipe Line Company has awarded contract for the immediate construction of a four-inch line from the Hendricks field, West Texas idstrict, to the Texas & Pacific railroad near Wickett, a distance of about 18 miles. This concern maintains headquarters in the Petroleum Building, Fort Worth, and plans to sell the oil handled to Louisiana refineries. Tankage has been erected on the Maxwell and Turman interests' producing lease to take care of one partially completed well until the line is put in operation and connections with other leases have been promised.

C. S. Luce has recently resigned his position as junior chemist with the Bureau of Mines at Bartlesville to go with the Stoll Oil Refining Company at Louisville, Kentucky.

HAMMER-WELDED Dephlegmators

DEPHLEGMATORS are only one of the tubular units in refining plants in which smooth surfaces, freedom from rivets and projecting seams and sound welds are desirable. By making dephlegmators, tanks, stills, retorts, etc., from "NATIONAL" Hammer-weld Pipe, which can be furnished plain or partly fabricated and in diameters from 20 inches to 10 feet, many advantages are gained. Such advantages include elimination of leakage and danger from explosions, freedom from undesirable accumulations, and higher efficiency in transmission of fluids and gases because of reduced frictional resistance. For more complete information write for a copy of "NATIONAL" Bulletin No. 13.

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Enlarged view of nozzle, showing smooth welding to shell of dephlegmator and substantial, efficient character of joint.

Caustic Added to Charging Stock Counteracts Corrosion

(Continued from page 54)

downward through the tower are conducted back into the next still in the battery from which point the distillation of kerosene starts, continuing this distillation down to the overhead stream of gas oil previously mentioned.

Gasoline Cuts Mixed

The gasoline vapors, which pass through the hot oil and series of bubble plates, then enter the upper compartment of the tower where they are conducted through a second series of bubble trays and out at the top as an overhead stream of finished gasoline. The upper compartment of the tower is subject to temperature control through the use of a closed coil through which cool oil is circulated. At present all gasoline streams are blended back together, producing about a 52-54 gravity gasoline meeting all specifications for U S. Motor Fuel.

The re-run still, No. 6, is equipped with a large bubble type tower, 62 feet by eight feet in dimensions, through which the still is charged with a portion of the feed. The remainder is charged direct to the still in the usual manner. The portion charged through the tower is employed as a reflux and temperature control medium, flowing down over the series of bubble plates after passing through a closed coil in the upper section of the tower, and finally passing into the still through the reflux line. In this manner the single re-run still is maintained in continuous operation. Re-running is to be discontinued at the Crystal plant in the near future, and then, as was anticipated, the bubble type tower erected on the sixth (or present re-run still) will be employed for production of kerosene and for close fractionation between the kerosene and gas oil cuts.

Tube Still Operation

Residuum from the battery of skimming stills varies from 16 to 18 A. P. I. gravity and is conducted from the last still at a temperature of about 525 F. It flows by gravity into a large horizontal flow, or "surge" tank, after passing through the heat exchanger, from which it is pumped to the tubular retort for reduction to gas oil and low gravity fuel. Charging pumps, two in number, one being auxiliary, which handle hot residuum charging stock to the tube still are Worthington size 14x6x12 inches. Two discharge pumps are also provided which conduct the reduced pipe still residuum through cooling coils and to storage, being of the same type, size 9 by 5¼ by 10 inches, Pumps handling recycle media over the top of the tube still bubble tower are also Worthington, size 6 by 4 by 6 inches. Control instruments employed in the operation of the tube still consist of two Leeds-Northrup temperature records, and two temperature controllers of the same make.

The tube still is a complete distillation and fractionating unit in itself, and through the use of the large bubble type tower three products are conducted through the receiving house. These cuts are benzine, light gas oil and heavy gas oil. The residuum, which is taken from the bottom of the tower is a marketable fuel oil. Yields of these products average about 6 per cent benzine, 5 per cent light gas oil, and 20 per cent heavy gas oil. The residuum contains less than 1 per cent free carbon and has a Furol viscosity of less than 300 at 122 F.

The still and the fractionating equipment in conjunction with it has a rated capacity of 5000 barrels. The still and furnace is 20 feet wide, 20 feet long and 20 feet high. It contains a little more than a mile of four-inch tubing—arranged in three banks. Fuel oil charged to the still first passes through a bank of preheater tubes behind the bridge wall, then through the banks of wall tubes, then up and through the roof tubes and gets its final heating in the soaking bank of tubes from where it flows to separator tower and the vapors conducted to condensers. Temperature in the furnace is kept at 1200 F. and the fuel oil charged to the unit is raised from 500 to 525 F. to 800 F. The heated oil passes into the fractionating vaporizer (bubble tower arrangement as described) at 800 F. and about 40 per cent is vaporized.

Cracking Units

The lower part of the tower is a separating shell, with bubble trays provided in the upper compartments. End point of the vapors passing out of the tower is controlled and fractionation assisted by a direct spray or recycling of the same prod-

This cooling tower we installed for the Marland Refining Company at their Ponca City plant is the largest single atmospheric cooling tower in the United States.

Cooling Water in the Modern Refinery

Refinery engineers are finding that the best practice in regard to the use of cooling water is to have one large supply of cold water serving the various stills, interchangers, and coolers. However, these various pieces of apparatus empty their water into the hot well at different temperatures and present a cooling water problem that only an expert can solve successfully.

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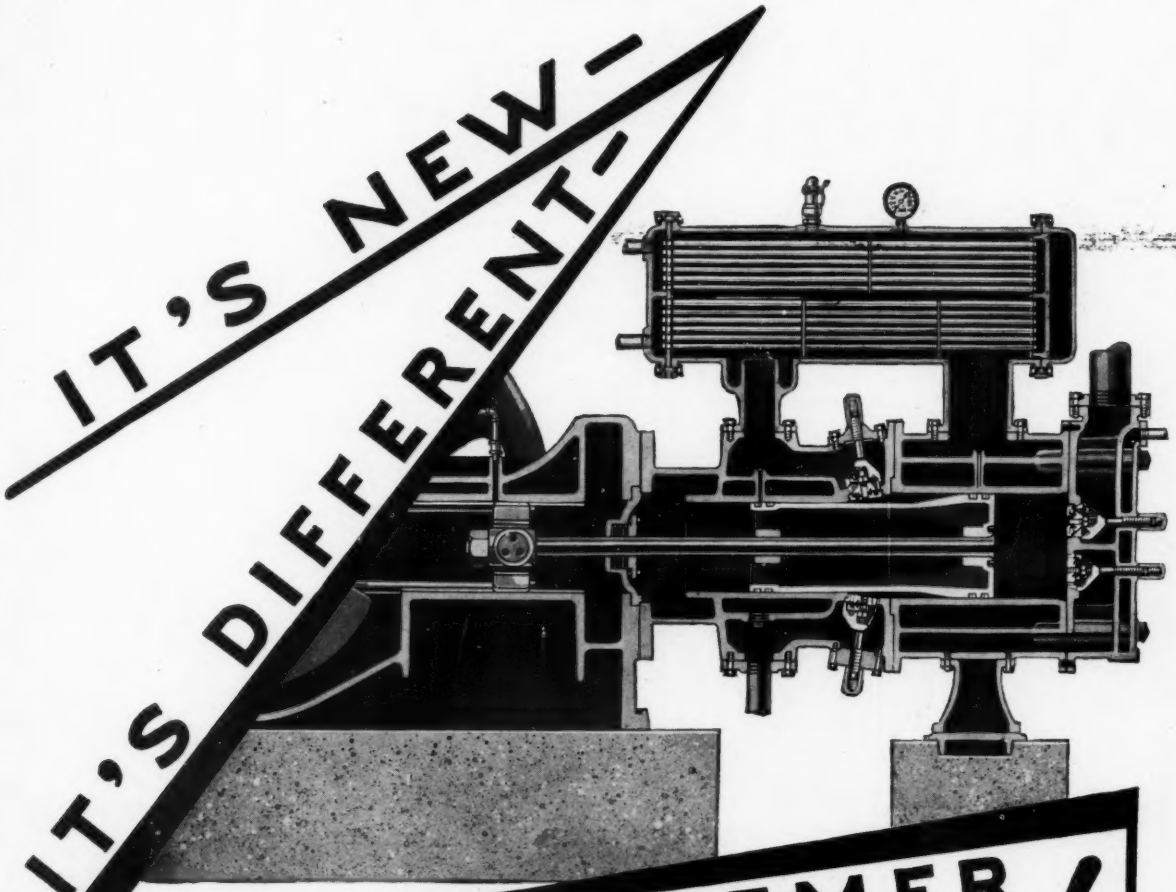

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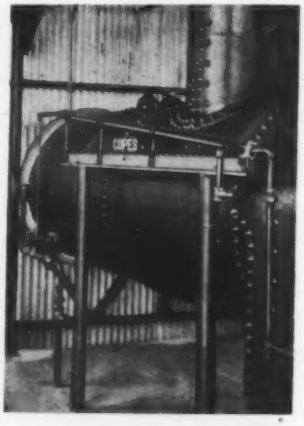
uct as it is taken overhead from the column. With benzine being taken off of the tower, a stream of this same product is circulated back over the tower where it comes in direct contact with the vapors leaving the column, which contact between liquid and vapors refluxes all undesired heavier particles, and at the same time the liquid undergoes a second fractionation and partial distillation. The benzine used as recycle media is injected into the power in proportions of about four to one, or four barrels of benzine are circulated for every five barrels removed.

The benzine cut taken from the tube still is rerun for its gasoline content. The light gas oil is either marketed or mixed with the heavy gas oil and charged to the Jenkins cracking units. These units are the high pressure type and among the first of their kind to be installed in the Mid-continent field by the Graver Corporation. The units are operated in the same general manner as the low pressure Jenkins units. They are built of 2½-inch plate and designed to operate at 300 pounds pressure. Operating below their rated pressure capacity from 110 to 140 pounds pressure being used, but somewhat above their through-put capacity of 1200 barrels each, daily, the units are producing about 70 per cent pressure distillate with a low carbon deposit, and unusually are kept on stream for 15 day runs. Still or oil temperature ranges from 760 to 780 F. and furnace temperatures from 1250 to 1300 F.

In addition to the extensive improvement program recently completed at the Crystal plant, the company is furthering its work of development and expansion through the installation of a modern absorption vapor recovery plant, which is at present under construction, and a new continuous treating plant to operate in conjunction with its present chemical treating facilities. Greatly increased storage facilities have been provided and loading equipment has been enlarged with present trackage for loading 100 tank cars. The company also has a completely equipped car repair or overhauling department in conjunction with the refinery.



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Topping Plant at Wickett Starts January 1

Dallas, Texas—The Blue Bonnet Oil & Refining Company, which has headquarters at 1009 Santa Fe Building, Dallas, has contracted with the Southern Crude Oil Purchasing Company for crude requirements of the topping plant now being erected on the Texas Pacific Railroad in West Texas at Wickett, and is scheduled to begin plant operations about January 1. Southern will deliver Winkler County crude to the plant, which is rated at 3000 barrels daily capacity, via a six inch line now connecting the field to Southern's tank farm and rack at Wickett.

A contract has been made by the Blue Bonnet Oil & Refining Company with the Texas Pacific Railroad for the delivery of a quantity of fuel oil, and the "tops" will be sold to other refineries in North and Central Texas, making deliveries in tank cars. A part of the equipment salvaged from the Elliot-Jones plant at San Antonio is being used in the Wickett plant. John T. Withers, Jr., Dallas, is president of the refining concern, and B. L. Woolley, Dallas, is secretary-treasurer. I. B. Chittenden is plant superintendent.

Nominees for Chamber of Mines and Oil Election

Los Angeles—Ballots for the election of officers and directors of the Chamber of Mines and Oil of California for the forthcoming calendar year are now in the mail. The list of candidates submitted by the nominating committee embraces the following: President, Chester W. Brown; vice presidents, Theodore Martin and R. A. Broomfield; treasurer, H. L. Westbrook; directors, E. L. Doheny, Jr., David S. Ewing, E. B. Gilmore, H. P. Grimm, W. R. Guiberson, Edwin Higgins, J. R. Hoffman, F. R. Kenney, M. E. Lombardi, A. B. Macbeth, A. C. Mattei, John McKeon, A. C. McLaughlin, E. J. Miley, H. L. Payne, R. L. Peeler, P. M. Pike, William Reinhardt, F. C. Ripley, E. M. Smith, R. A. Sperry, F. C. van Deinse, A. L. Weil and Philip Wiseman.

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Wax and Its Manufacture

By GEORGE W. CUPIT, JR.,
Chemical and Refining Engineer

IN the early refining of petroleum oil the subject of wax production was scarcely known, principally because its nature chemically was undetermined, and the purposes for which it could be used were undeveloped. It was a known fact that Pennsylvania oils possessed a high wax content (sometimes referred to as paraffine content), but the nature of the same was, and still is, very complex. However, with all its complexity, the homologous series to which it belongs is now known. This is true with regard to that wax we call "crystalline." If it were for this kind of wax alone the problem of complete isolation would not be so diffcult to solve. There is another kind of wax present in paraffine base oils which is referred to as "amorphous" wax (without crystalline form). Each kind presents a different and interesting method of isolation and refining.

Since the crystalline wax is in more demand than the amorphous, certain methods of refining have been developed to convert the amorphous to a crystalline form. The conversion is by no means complete, for there still remains in the original fraction some amorphous wax which is either removed by some other method or allowed to remain as such. The methods for the removal of both kinds of wax will be discussed later in this article.

Methods of various kinds have been applied to remove both kinds of wax from the natural oils, or distillates from same. These have been for the most part solvent extraction or precipitating methods. So far they have proved unsuccessful, especially commercially. It may be said, in this respect, that our petroleum chemists are getting closer and closer to its solution every day, as may well be seen in the article, "Use of Solvents for Dewaxing Paraffine Crude Oil," by H. M. Smith, published in the October, 1927, issue of The Refiner and Natural Gasoline Manufacturer. In reference to precipitating methods, I mean precipitation by use of chemicals, without affecting the remaining components of the oil. Certain chemicals have been used to precipitate the wax in an oil, but their recovery has been found too costly for practical purposes, and the chemicals must be removed before further refining of the wax is possible. Further progress has been made in the case of inert solvents than in the case of chemicals.

Watch the Still

The most successful method for the removal of the wax has been chilling and pressing. Each, of course, is a separate operation and is carried out, using distillates from paraffine base oil, rather than the crude oil itself. It should be remembered that in the distillation of the crude oil for that fraction containing the maximum amount of crystalline wax certain still conditions must be carried out with absolute accuracy, for good wax is made, not in treating, sweating, or filtering, but in the still. Too many refineries direct attention toward one or more of the above mentioned, thinking that acid treating or filtering is the important point in the refining. What they should aim at is quality of the paraffine distillate. It is impossible to make the best fully refined wax from a poor paraffine distillate. It is just as easy to make good paraffine distillate as it is to make poor distillate.

There are various crudes which give better wax than others, namely, Pennsylvania and Mid-Continent (Oklahoma, for instance) and should be used when the production of good waxes is desired. These are examples, and do not include all the good wax-bearing crude oils. Good wax, then, is made on the stills. Paraffine distillates may be obtained by following two general methods of distillation: first, by running directly from crude oil, and second, by topping the crude, treating the reduced crude with 66-degree Be. sulphuric acid, neutralizing, washing, and then redistilling to get the paraffine distillate stock.

Straight Running

The oil chosen for this work was Eureka Pennsylvania Crude, having a gravity of 42.5-degree Be. and possessing a pure paraffine base quality. The methods for charging and firing the still have been discussed in a previous article and will, therefore, be omitted. The method of fractionation follows:

Cut No. 1—Over to 60 degrees Be.—Crude Naphtha.

Cut No. 2—60 degrees Be to 51.5 degrees Be.—Special Water White.

Cut No. 3—51.5 degrees Be to 41.0 degrees Be.—Ordinary Water White.

Cut No. 4—41.0 degrees Be. to 39.0 degrees Be.—300 Stock.

Cut No. 5—39.0 degrees Be. to 31.0 degrees Be.—Paraffine Distillate.

Cut No. 6—31.0 degrees Be. to Off—Paraffin Rerun Stock.

Cut No. 7 — Bottoms — Cylinder Stock Bottoms.

Cut No. 6 may be rerun for paraffine distillate by cutting into paraffine distillate tank at 37 degrees Be. and cutting out at 160 Vis. at 100 degrees F. Saybolt. This fraction may be added to cut No. 5 for further processing.

Without exception, paraffine distillates made from Pennsylvania crude oils are of such high quality that a washing previous to chilling and pressing is unnecessary.

Refrigeration for Pressing

The machines used for chilling the distillate were standard Carbondale absorption machines, with a total capacity of 700 tons of refrigeration. The amount of water used on the atmospheric coils, weak liquor coils, condenser and absorber of each machine, ranged from two and one-half to three gallons per minute, per ton, in winter to four gallons per minute, per ton in summer. Artesian water was used in summer and river water in the winter. The temperature of the artesian water ranged from 54 to 60 degrees, coming from the ground and left the coils at a temperature of 90 degrees F., while the river water in summer had an average of 81 degrees F. and left the ammonia coils at a temperature of 90 to 102 degrees F. It will be seen, at a glance, the important part water plays in a refrigeration unit, when it is learned that artesian water gives a generative pressure of 156 pounds, as against 176 pounds pressure using river water at the above temperature.

Preparation for Pressing

An important point to keep in mind when first chilling paraffine distillate is not to chill too fast before the formation of crystalline wax takes place. Several methods of chilling have been worked out for speeding up the formation of crystals, but it has been found that by adding an activator the best and quickest results may be obtained. A small percentage of low melting point wax (98-100 M. P.) added to the paraffine distillate speeded up the formation of crystals, but on pressing, the wax crystals were not of the best quality. The activator which finally gave the best results was foots oil. This oil caused the formation of small, pure crystals, and in a much shorter time than the low melting point wax.

In order to press the wax out of the distillate and foots oil, the mix should be chilled to 12 to 14 degrees F. The cold test of the distillate will then range from 21 to 22 degrees F. Chilling is done by means of river water, pressed oil and brine, which has been chilled by ammonia. The paraffine distillate is first pumped through a cooler filled with river water. This lowers the temperature of the distillate from 95 to 100 degrees F. to 88 to 90 degrees F., with river water at approximately 82 degrees F., or a little above. A second cooler connected to the first is

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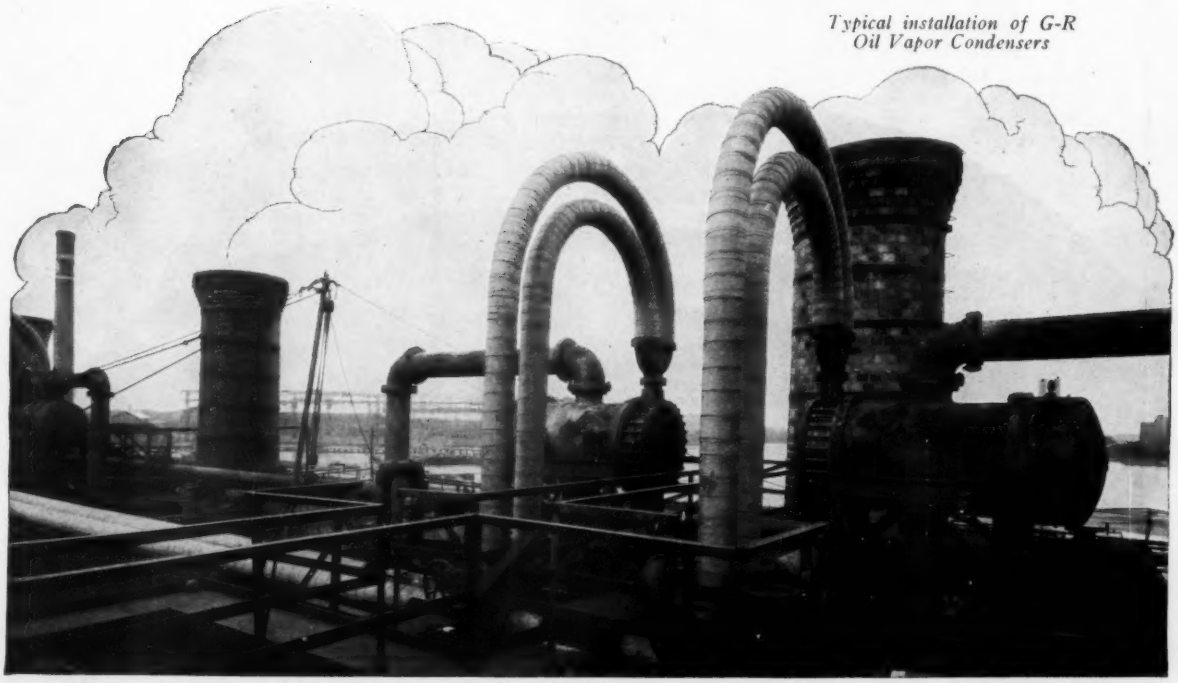

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used, and this cooler lowers the temperature of the distillate another four to five degrees which brings the temperature down to 84 to 86 degrees F., leaving the coolers.

Pumping of the distillate is done by a 15x5x18 inch block valve National Transit double action pump, with a six-inch suction line and a four-inch discharge to four-inch coils in coolers and continuing four-inch to the preliminary Carbondale chilling machines, where the pressed paraffine oil direct from the presses, with a temperature of 40 to 43 degrees F. is used as a chilling medium. The unpressed distillate and the pressed oil are pumped counter current through the Carbondale machines, entering at the top and bottom, respectively, and leaving vice versa. The pressed oil leaves the machines at 66 to 68 degrees F. and the distillate at 70 to 72 degrees F. The machines may be used in series. The pressed oil may be pumped through the machine from an underground tank which acts as a receiving tank for the presses, by means of a belt-driven Kinney pump, running continuously at a pressure of 20 to 25 pounds. From the Carbondale machines the pressed oil goes to storage.

Cold Brine Chilling

After passing through the preliminary chillers, the distillate goes into a small (100 barrels capacity) reserve tank, from which it is continually being pumped by another 15x5x18-inch National Transit double-action pump through the cold brine-chilled Carbondale machines. These machines are connected in parallels with a two-inch connection from a four-inch header and a ¾-inch by-pass by means of which the feed of each machine is regulated. The pressure on the main is 350 to 400 pounds. The distillate leaving the machines is kept at a temperature of 12 to 14 degrees F., and this gives a cold test temperature of 21 to 22 degrees F.

The distillate temperature leaving the cold machines must be kept uniform to secure correct cold test and best wax.

The temperature of brine (calcium chloride 28 to 20 degrees Be.) entering these cold test Carbondale machines must be kept within one to two degrees of zero, and leaving the temperature six degrees high. This range of six degrees is adhered to in cold chilling. The brine is circulated through the machines and brine coolers by means of Worthington Turbo three-stage, motor-driven pumps at 60 pounds pressure. The brine chilled distillate flows into a second reserve tank (100 barrels capacity) and from there is continually pumped to the presses.

Pressing Paraffine Distillate

After the press has been dumped (from a previous run) the head is pushed forward by means of a hydraulic ram, with 20-inch cylinder, the pressure being supplied by a Gould triplex belt-driven pump, using pressed oil as a hydraulic pumping medium. In making up a pressure on a press the final pressure should be between 950 to 1000 pounds, and a full nut shoud be made up on all three-inch rods of the press. The number of these rods generally is eight. If a full nut cannot be had at this pressure, one or more plates must be removed from the press, or plates added if pressure required to make up press does not equal 950 to 1000 pounds. This is to insure a tight gasket joint between rings and plates, and to prevent the press from leaking without putting too great a strain on the eight rods which hold the press together while running.

The next step is to clean the apron on each side of the press free from wax that sticks after dumping, so that when the press begins to filter this wax will not be washed into the pressed oil, thereby raising the cold test. A trough is then laid directly beneath the center of the press to catch the pressed oil which flows into underground tanks previously mentioned. As soon as the aprons are cleaned and the trough is in position, the valve from the filling pump is opened into the empty press. The press is kept on this pump at a pressure of 150 pounds for an hour or so, until one or two more presses are dumped, and then the valve from this filling pump is closed, which is on the manifold at the rear end, inside each press room. The valve from the

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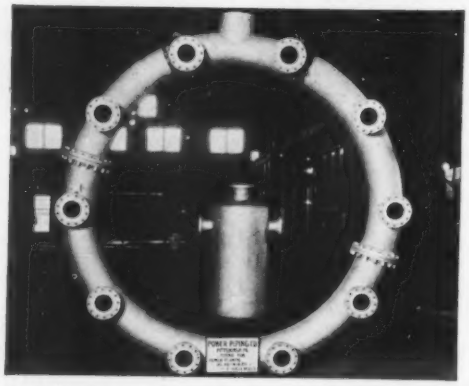

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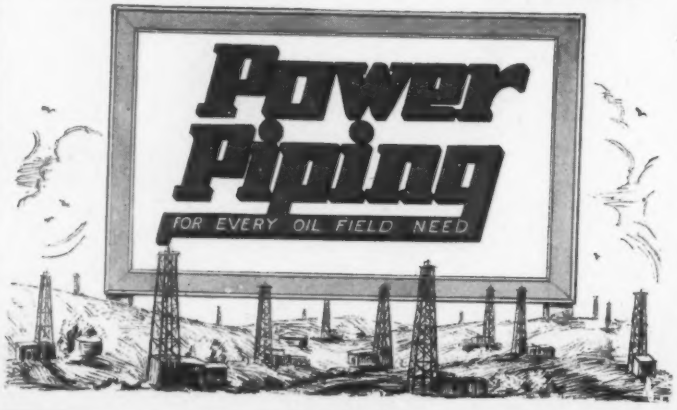

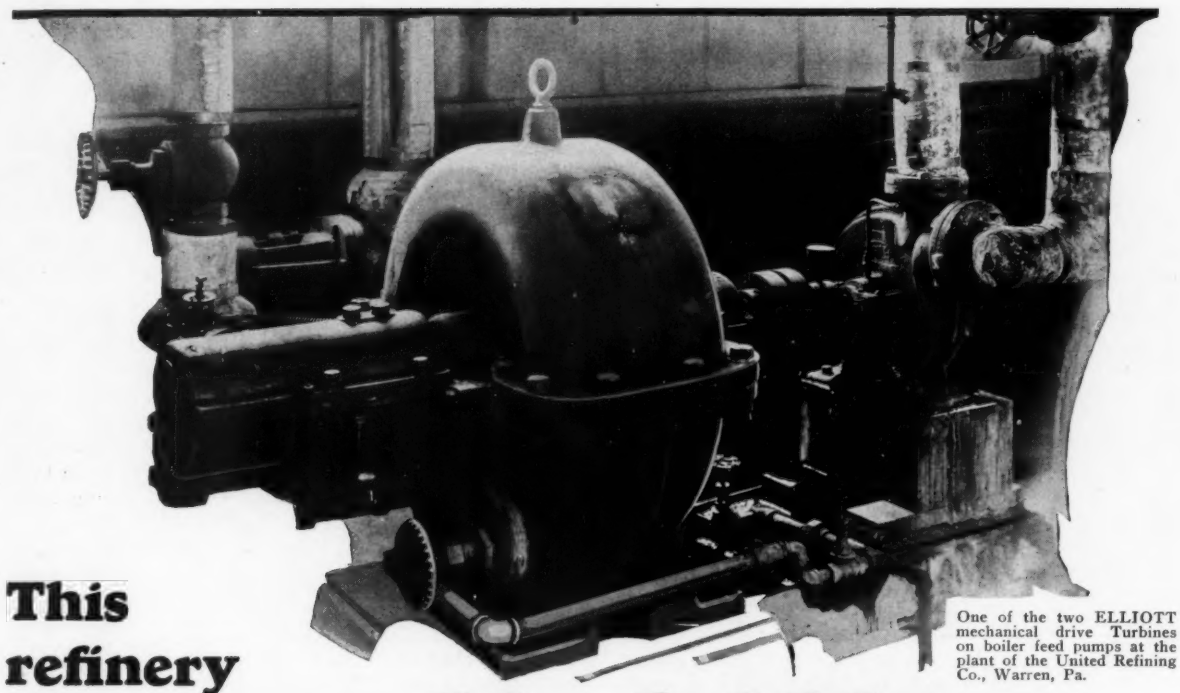

One of the two ELLIOTT mechanical drive Turbines on boiler feed pumps at the plant of the United Refining Co., Warren, Pa.

This refinery demands reliability

Placing a high value on non-stop production and the equipment which maintains it, the United Refining Company, Warren, Pa., use two ELLIOTT 20-hp. non-condensing turbines for driving boiler feed pumps. The turbines operate on a steam pressure varying between 60 and 80 lbs., exhausting at a back pressure of 5 to 10 lbs., the exhaust going into an open heater. "They have operated perfectly since installed," says the Chief Engineer.

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pressure pump is opened and the pressure increased to 300-350 pounds and kept constant for 12-20 hours, or until a hard cake of wax is formed. The press is carefully examined from end to end by means of an electric extender for any leaks which may occur between the rings and plates. If any leaks are located, leakers are placed so that the unpressed distillate passes over the trough into the cellar. These cellars are pumped daily, the water is settled out and this slop is pumped back to the mixing tank, together with fresh distillate and foots oil.

The flow of pressed oil and the cold test are reliable guides as to when the press is ready to dump. If run too long the flow of pressed oil will decrease to less than five barrels per hour, and the cold test will go up, because the wax will burst through the gasket joint. In short, the flow of pressed oil diminishes with the number of hours running, so in order to get a greater number of barrels per press for a 24-hour period, dump the press as soon as a cake of hard wax is formed. This will vary from 12 to 24 hours, depending upon the grade of distillate used.

When the press is ready to dump the pressure valve on the manifold is closed and the pressed oil trough is pushed to one side. The screw is turned back in order that any oil in the wax trough around the screw will be carried back into the cellar and not into the dump tank. After the trough is clear, the direction of the screw is reversed, so that the wax cakes, as dumped, will be carried to the dump tanks in the rear outside press rooms. Before press can be dumped, the head must be pulled back the length of the ram which is about four feet. In order to do this, all valves on the main discharge and return lines must be closed except those of the press to be dumped, and these must both be opened. The four valves on the manifold of the hydraulic cylinder are then s l o w l y opened: Firstly, the valve admitting the pressure at the front end of the cylinder and a by-pass valve into the return line. Secondly, outlet valve on cylinder is slowly opened and by-pass valve shut. The pressure is regulated by the outlet valve and the by-pass valve. As soon as enough pressure is exerted on head, to take strain off the eight nuts on three-inch rods, these nuts are removed and head is slowly pulled back, until it is up to the cylinder. The press dumpers then start to separate the plates from each other by placing paddle between ring and plate, using it as a lever. It is important that pressure be exerted against the ring, and not against the canvas, as otherwise the canvas will soon be worn out at this point and cause the press to leak. At this stage of processing the wax has been removed from the paraffine distillate by means of the filter press and is called "slack wax." The oil, which has passed through the press is called "pressed paraffine distillate."

Processing Slack Wax

If the slack wax is dirty, which is very seldom the case with distillate run from Pennsylvania crude oils, it is sent to the treating plant where it is washed with approximately 30 per cent by volume, of hot milk water until clean. The milk water is retained from the washing of acid treated and neutralized paraffine lubricating oils. After the slack wax has thus been treated (if necessary), it is ready for the sweating ovens.

The first step in sweating is that of raising the spouts in the pans and then filling the pans with water to the level of the one-fourth-inch galvanized wire mesh screen which is approximately an inch above the bottom of the pan. The pans are filled to the top with wax to be sweated. Before wax can be sweated, it must be chilled down to a temperature of at least as low as the melting point of the lowest cut made. This cooling is done partly atmospherically and partly by cold water circulating through three-fourths-inch coils situated in the middle of the wax cake. In summer as much artesian water is used as is available, but in cold weather river water is used. This water is pumped by means of a 7½x5x10 National Transit double-action pump and after leaving the coils which are connected from each pan in parallel, it goes to the sewer. In order to hasten the atmospheric part of cooling, the oven is provided with doors on all sides and the roof is also liberally supplied with openings. These are thrown open as soon as the oven is finished melting down, and left open until the oven has been again charged with wax and chilled down to required temperature for sweating.

Chilling, if allowed to proceed too far in cold weather, will go below the optimum point for sweating, and much longer time will be used in sweating than is necessary. The bottom pans will chill more quickly than the top pans, so the bottom doors and windows must be closed first and the top doors and windows last, else the bottom pans will be too hard by the time the top pans are ready for sweating. The temperature of the room and the water pumped through the coils is raised just fast enough to sweat out the intermediate grades of wax without melting down the yield until the last. Toward the end of the run, the oil content of the wax in the pans and the coler of the stream are noted. When the dirt (if any) and oil have been rid of, live steam is turned into the pans and the oven is melted down. During melting, the water circulating through the coils is stopped.

Sweated Wax

The spouts are lowered, allowing water to flow away from the pans, and this is followed by the first cut of the wax charged. As sweating continues, the stream is sampled for melting point and when the upper limit is reached, it is switched into a different drip, or the pump emptying the drip can be discharged into another storage tank. When the intermediates have been sweated off, that which is still left in pans is the yield and that is melted down with open steam and the oven doors opened. This completes the cycle of sweating.

Of course, the sweating is continued until a sample from the stream shows the melting point and color of the wax left in the pans to be up to the standard for that particular grade. Before the pans are again filled with water to the level of the screen, they are thoroughly flushed down with water which carries away dirt which has settled out of the wax during sweating process. The wax obtained by this sweating process is called "crude scale wax." If the demand for sweated wax is greater than that for scale wax, the crude scale wax is again charged into the ovens and run for "sweated wax." The yield from this sweated wax gives the highest melting point sweated wax, which is usually 130 degrees M.P., or higher, going as high at times as 134 degrees M.P.

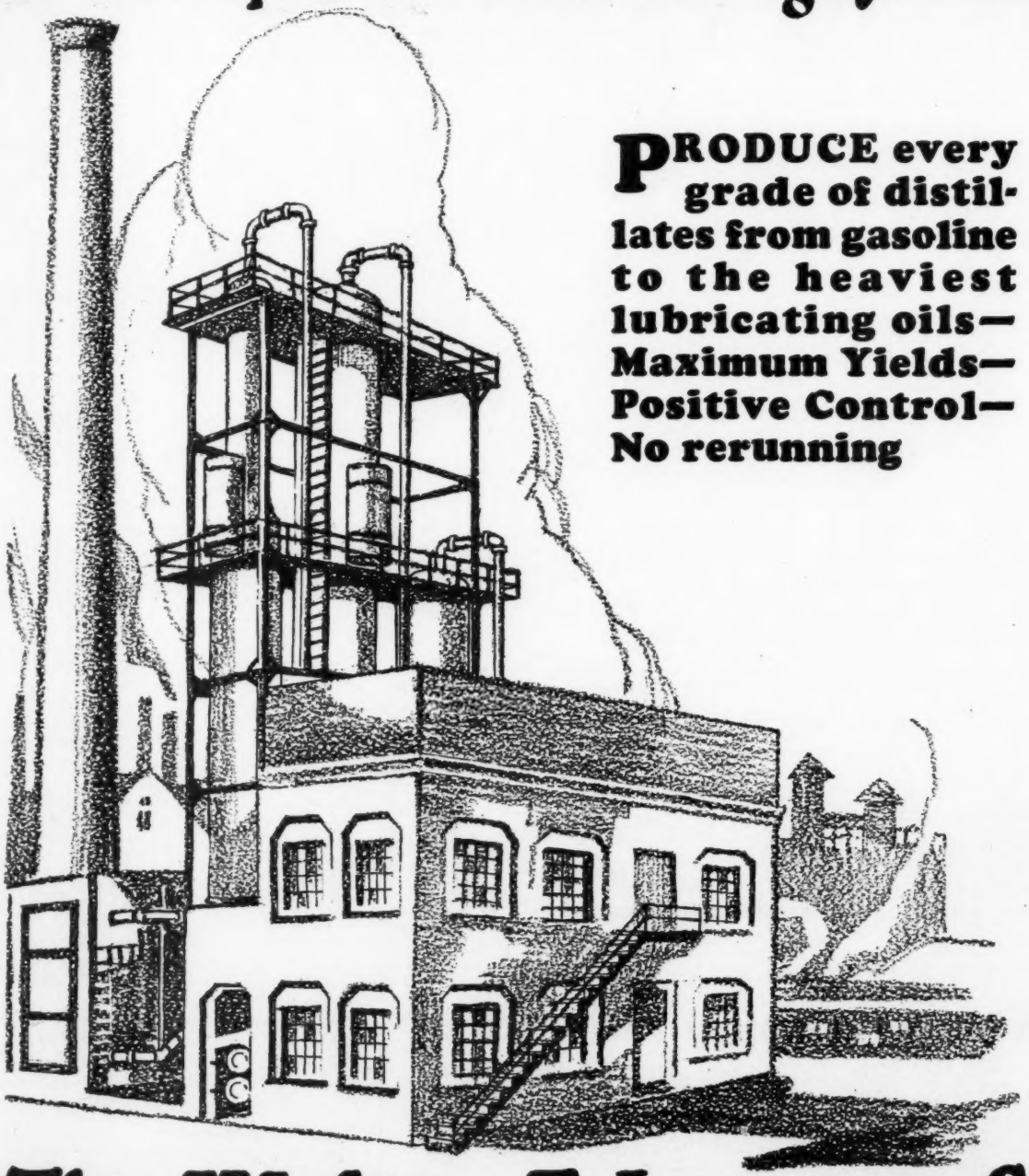
This high melting point wax does not have to be treated and is, therefore, sent to the filters where it is filtered to 20 color. The second and first intermediate scale waxes, which are obtained in the order named in sweating crude scale wax, have to be charged to the ovens and melted down (or run down) for sweated wax. The following table will show the standard practice in sweating:

Charge	1st Cut
Slack wax	Foots oil
Crude scale wax	2nd Int.
1st Int.	2nd Int.
2nd Int.	3rd Int.
3rd Int.	4th Int.
4th Int.	Sweat oil
2nd Cut	Yield
Int. slack wax	Crude scale wax
1st Int.	Sweated wax
1st Int.	Sweated wax
2nd Int.	Sweated wax
3rd Int.	Sweated wax
4th Int.	2nd Int. scale

The sweat oil is the lowest melting point obtained in sweating, and usually contains amorphous wax, and this is sent back to the refinery and charged up with gas oil. Should the sweat oil obtained in sweating fourth intermediate scale contain wax of crystalline nature, it can be placed in a tank and allowed to chill down in cold weather. The wax crystallizes out and settles to the bottom and the amorphous wax and oil will still be liquid remaining on top. The surface will chill down to a solid

LUMMUS

Low Temperature Refining Systems



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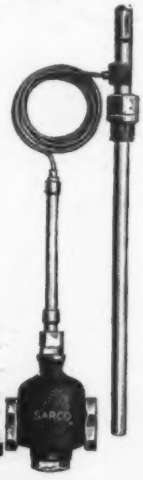

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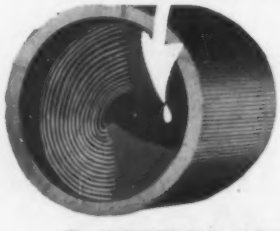
SARCO Temperature Regulator

The Spiral Motion Is the Trick



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Used by all big producers because of the intensive movements.

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state and as it gets too heavy to support its own weight, will drop to the bottom of the tank, where the oil and wax will separate, making it easy for the oil to be pumped away. The wax can then be melted by means of steam coils and be pumped away. If oven space is available, this re-sweating can be done there aslo.

The sweated wax from first, second and third intermediate scales is then sent to the treating plant in 700 to 800 barrel charges and given an acid treat to remove any organic matter present, and with this gone, the color obtained in filtering is permanent. As far as possible, the sweated waxes from the different intermediate scales are blended before acid treating to make the required melting point desired, but blending for melting point and color also can be done after treating and filtering is completed.

Many refineries use another method for processing the acid treatment of wax in that instead of acid treating the various grades of sweated waxes, they treat the paraffine distillate, neutralize, and wash it prior to chilling and pressing. In this event, the treating of the sweated cuts is omitted. Of the two methods, better results have been obtained by acid treating the various melting point grades of sweated waxes, although this procedure is the more difficult, especially in winter. The stability of the finished products, to both light and heat, is greater. The acid treatment of sweated waxes is by no means an easy proposition. It is simply a matter of selecting the better method of refining to give the best refined finished products. Some refineries are able to sell all the wax products they make, regardless of the method of refining used and the quality of those products, and are, therefore, willing to let it go at that. Other refineries are operated on a quality basis of their finished products and in the long run profit accordingly. It is unnecessary to mention the names of such refineries. An examination of their yearly statements will indicate sufficiently which they are.

The subject of the refining of waxes is so detailed, and cover such a wide field that I shall not endeavor at this time to cover it from beginning to end, but shall leave the acid treating, filtering, and packing to a subsequent article to be published in the near future. At that time will also be discussed vital points in its manufacture which will be contained in the conclusion.

J. J. Thomas, for the past year and a half superintendent of the Crystal Oil Refining Corporation's Shreveport, Louisiana, refinery is at present acting superintendent of the plant, succeeding D. H. Christman who resigned, effective November 11, to take charge of the refinery of the Shreveport Producing and Refining Company at Jewella. Mr. Thomas was formerly with the Skelly Oil Company, Tulsa.

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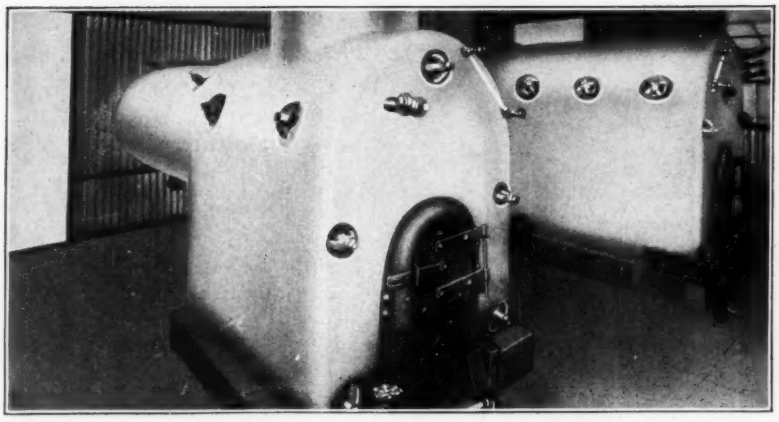

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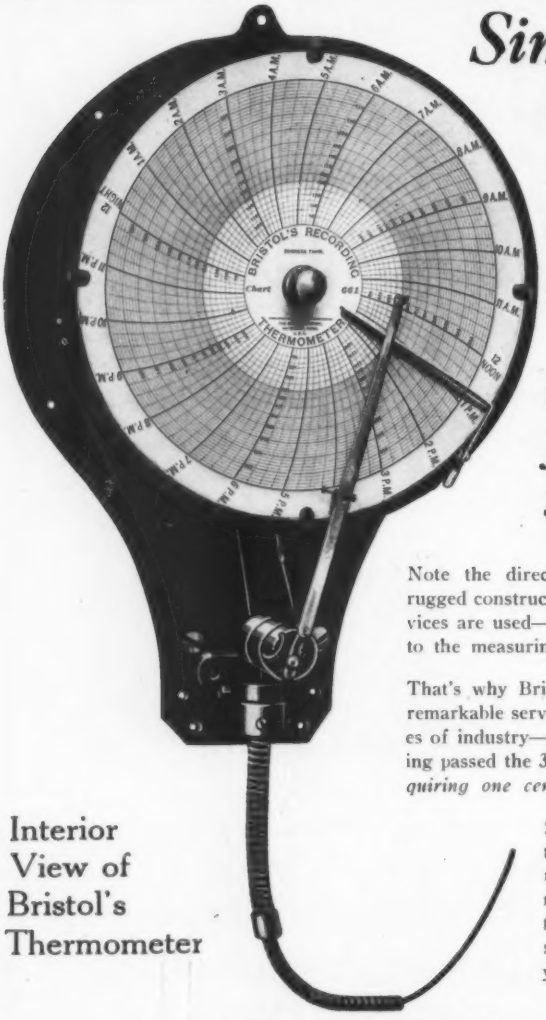

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Natural Gasoline Association Group Meeting Held at Breckenridge

(Continued from page 51.)

cle engines, were the subject of inquiry and interesting discussion among those present.

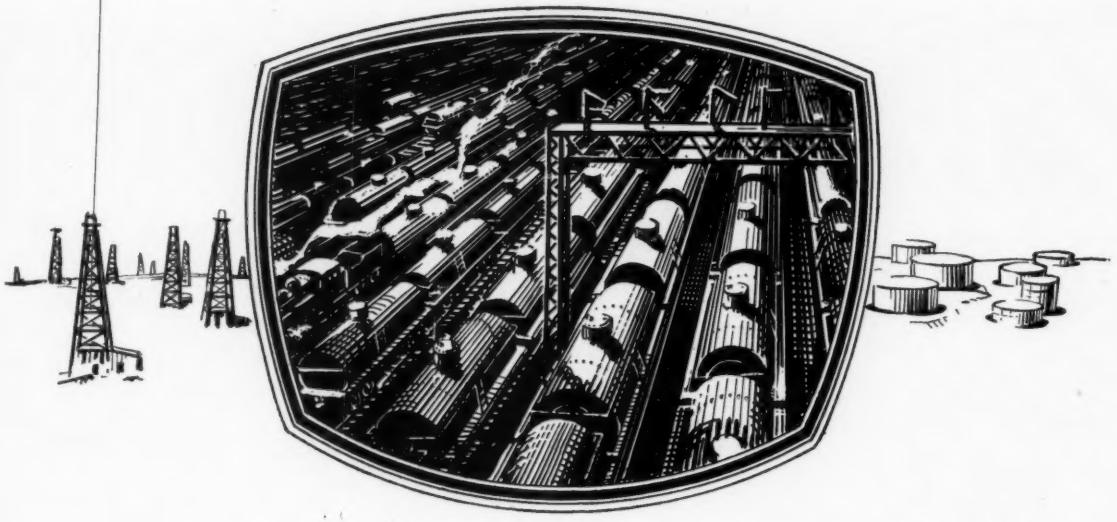
The importance of positive air filtration in gasoline plants was stressed in a paper by O. F. Kluenter, Smith Separator Company, Tulsa. A sample of dust as is removed from the air entering engines in gasoline plants was interestingly inspected by those in attendance. Unfiltered air is responsible to a certain extent for a large part of gasoline plant operating troubles, the dust present in air entering the engines contributing to frequent valve grinding and replacement, reboring of cylinders, carbon deposits are greatly augmented, loss of capacity is a direct result, as well as excessive consumption of lubricating oil.

D. A. Sillers, chief of the gas department, Lone Star Gas Company, called attention to the importance of close co-operation between the field department where orifice meters are installed, repaired, and orifices changed, and the chart department where calculations are made to determine the volume of gas passing through such meters. In his discussion of the gas measurement he outlined many of the factors contributing to erroneous calculations which are costly to companies buying and selling natural gas. He presented a card system for checking condition of meter and size of orifice through the field and chart departments, as used by the Lone Star Gas Company, the details of which were offered to those members interested. Mr. Sillers concluded his remarks with a comparison of the accuracy of the gravity bottle and the gravity balance instruments for determining the specific gravity of natural gas, pointing to the higher accuracy of the balance.

Positive evidence of increased interest in safety work was manifest through the group discussion of C. L. Hightower's paper on "Plant Safety in Natural Gasoline Plants." Mr. Hightower is safety engineer for the Texas Pacific Coal and Oil Company. The subject of static electricity was discussed by several members who cited instances where fires were known to have been caused by lacking of proper grounding.

F. R. Staley, chief chemist, Texas Pacific Coal and Oil Company, told the group of operators something of the problems of chemical treating of refinery products, and briefly outlined the details of various treating methods and process, touching upon the chemistry of the various reactions. Following the talk there was some interesting discussion of sweetening methods of natural gasoline derived from sour or sulphur bearing gases. T. G. Laney, Smith Separator Company, concluded the program with a paper on the "Application of Regulators and Temperature Controls in Plant Operation."

The visiting operators in attendance at the group meeting were entertained by the Brooks-Hanlon organization at its plant close to the city with a barbecue lunch during the noon hour.



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During the past year The Refiner and Natural Gasoline Manufacturer has printed more than 50 articles of a technical nature of direct interest to refiners and natural gasoline plant people.

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Using Chemicals Protects Equipment Against Corrosion

(Continued from page 58)

weighed initially and are weighed again at definite intervals, e.g., every month, to determine the loss. From the loss of weight and the area of exposure, the rate of corrosion can be calculated. Steel samples 10-inch by 10-inch by one-fourth-inch machined smoothly, and with a hole near one corner for suspending them are suitable. The sample should be suspended with nichrome or similar wire which does not corrode under the conditions of the test. On removing the samples they shold be carefully cleaned before weighing. The rate of corrosion as obtained over monthly periods may be plotted and used as a control of the amount of chemical to use.

Soda Ash

Soda ash, (sodium carbonate) causes less deposition of coke than caustic soda. It is cheaper than caustic soda per unit of alkali content.

It is injected in a similar manner to caustic soda. The solution is made approximately 10 degrees Be. and the proportion required is approximately 25 per cent more by weight than for caustic soda.

Lime Injection

In order to overcome the disadvantages of the use of caustic solution, such as secondary corrosion or caustic embrittlement, or both, and the formation of a hard coke in the heating tubes which gives difficulty in removing, lime has been substituted for caustic soda with marked success.

Quantity Required

It has been found that the use of 0.4 to 1 pound of hydrated chemical lime per barrel of raw oil charging stock will be satisfactory for most corrosive oils; less can be used with betcharging stocks. The exact amount to be used is a matter of experiment for each oil undergoing distillation.

It is recommended that dry "chemical" hydrated lime of approximately 200 mesh be used. The hydrated lime may be added to a portion of the charging stock and mechanically agitated so that it remains suspended in the oil.

The lime is injected at the same point of the cracking system as in the caustic soda method already described. Preferably a tank should be provided to hold a full 24-hour supply of lime suspension. This would amount to approximately 10 barrels of lime suspension per 1000 barrels of cracking capacity. It is advantageous to provide duplicate tanks so that the lime can be mixed in one while the other is in use. It is also advisable to provide a mechanical mixer to keep the lime stirred and maintained in a state of suspension. Where the tank is placed outdoors, a steam coil should be provided to warm the contents in cold weather.

Figure No. 8 shows an arrangement of tank and the circulating line which carries the lime solution to the injection pumps on all units. A 4½x2¾x4-

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inch or 6x4x6-inch reciprocating pump with all-iron fittings may be used for this service. Up to a capacity of four 1000-barrel cracking units the circulating line may be 1½-inch. For greater cracking capacity the 6x4x6-inch pump and a two-inch circulating line should be used. The return line may be taken to the center of the mixing tank and pointed downward. This provision assists in agitating the lime and maintaining it in suspension. A flow of 10 to 20 gallons per minute through the line will keep it clear and prevent set. tling.

An injection pump should be used for each unit; however, a single pump may be used for a battery of units.

Where a separate reciprocating pump is used for the raw oil feed of each unit, this injection pump can be operated directly from the feed pump. This arrangement has been found to give satisfactory results.

The reciprocating motion required is obtained by fastening the slotted arm of the injection pump directly to the rocker-arm of the raw-oil pump. The rate of injection can then be controlled my moving the link along the slot. This arrangement is shown in Figure No. 9.

Motor-driven pumps may be also used to give a constant rate of flow.

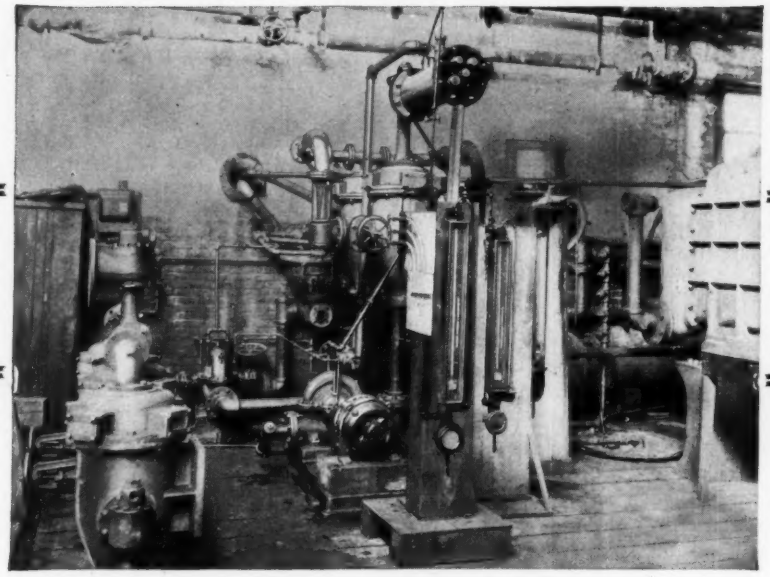
Some of the advantages resulting from the use of lime follow:

1. The heating tubes are more easily cleaned as the lime apparently yields a protective covering between the steel and coke, preventing its close adherence.
2. The structure of the coke in the reaction chamber is improved so that a smaller amount of fines or breeze is produced in cleanouts and in handling. The coke is more readily broken up in the chamber.
3. The cost of operation will be less than when using caustic soda, due to the lower cost of the lime.
4. Corrosion is decreased materially.

A further and important advantage in the use of lime has been noted in connection with the cracking-operation in which the residuum is flashed. The coke formed in the reaction chamber when no lime was used was so dense and hard that it was difficult to remove. By the use of lime as a protecting agent against corrosion, or for the sole purpose of reducing the breaking strength of the coke, this operating difficulty has been overcome.

The following tabulation shows the analyses of the coke produced by a cracking unit when lime is charged into the system and when it is not charged.

	Quantity of Lime Used 0.4 Lbs. Per Bbl. of Oil Charged	None
Proximate Analysis:		
Moisture	2.73	3.23
Volatile matter	11.85	13.28
Fixed carbon	78.71	81.94
Ash (inclusive of lime)	6.71	1.55
Lime	3.97	...
Sulphur	1.23	0.77
B. T. U.	14,252	15,219



Vacuum Pump for Oil Refinery *On Test*

THE photograph shows a Wheeler Three-stage Vacuum Pump for a large oil refinery, set up for tests in the Wheeler laboratory. All Wheeler Vacuum Pumps are tested for capacity at the specified vacuum before shipment. Customer's representatives are invited to witness these tests.

The simple construction of the steam jet vacuum pump insures maintenance of test capacities in the field. Adjustments are unnecessary (in fact impossible) after the steam jet leaves the shop. Economy is maintained throughout the life of the machine without the need of attention or repairs.

For further information, write

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Of Particular Interest to the Plant Operator

Cracking

THE Corona Discharge in the Cracking of Petroleum. (*Petr. Times, Feb.* 12, 1927, P. 302)—Experiments by the Bureau of Mines (Tech. Paper No. 375, Jakosky) indicated an increase of only 5 to 8 per cent in cracking of petroleum oils under the influence of the corona discharge. It is probable that more considerable results could be obtained by utilizing the mechanical or precipitating action of the corona upon the heavier hydrocarbon vapors in the exit tube as they pass out of the cracking chamber along with the cracked vapors. Precipitated upon the walls of the tube, they would be returned to the still. This would mean the saving of the heat lost in condencing and revaporizing these heavy fractions, and an increased thermal efficiency for the still gained by keeping the heavy hydrocarbons in it.

The corona could also be used in condensers to prevent or reduce the channeling of the vapors as they pass through. The electrostatic precipitator could be made to act, that is, as it does in the precipitation of the acid mist in a sulfuric-acid plant.

Fractionation

Improving Fractionation in Petroleum Refining.—(*Keyes. Chem. and Met. Eng.* 34,164 (1927). *B. C. A.-B, May* 13, 1927, *P.* 323.)—It is suggested that in the refining of petroleum by means of a bell-cap fractionating column, without reflux, connected to a pressure still by a vapor line and a liquid return, over-cracking may be prevented by the application of more modern systems of fractionation as used in other processes, e.g., the distillation of alcohol. Owing to the formation of gummy substances during fractionation, the introduction of a number of storage plates in the fractionating column would be desirable in order to allow sufficient time for the deposition of gums.

Treating

Purification of Cracked Gasolines—Joseph. Rev. chim. ind. 36 16 (1927). *C. A. Apr.* 20, 1927, *P.* 1346.)—The use of aluminum chloride instead of stannous chloride not only decolorizes but desulfurizes and saturates the gasoline. Refluxing cracked gasoline for two hours with 5 to 10 per cent of aluminum chloride caused the formation of tar conta'ning aluminum complexes from which the gasoline separated completely on cooling. The gasoline was purified by washing with 10 degree Beaume sodium hydroxide, and redistillation is superfluous. By this process, cracked gasoline containing 1 per cent of sulphur from Mexican (Panuco)) crude containing 5 per cent of sulphur gave a perfectly clear, saturated gasoline with 0.01 per cent of sulphur or less; and the gasoline did not subsequently turn yellow and form a deposit as occurs with cracked gasolines purified with sulfuric acid.

Action of Sulfuric Acid on Petrol.—(*Ormandy and Craven. J. I. P. T.* 12 68 (1926)). *B. C. A.-B, May* 28, 1926, *P.* 395.)—The authors treated two petrols with sulfuric acid in a series of washes, the strength of the acid being steadily increased with each wash from 79.1 to 100.5 per cent. Determinations of percentage loss of weight, density, refractive index, and aniline point, following this treatment, indicated that polymerization and removal of unsaturated compounds takes place with acids below 88 per cent, and that with acid above that strength removal of aromatic compounds takes place.

Filtration

The Contact Clay Process for Refining Mineral Oils.—(*Moore, Petr. Times, July* 16, 1927, *P.* 115.)—The acid tar, which is distributed in fine black particles or "pepper" all through an oil after an acid wash, can practically never be settled out. When the oil is then washed with water, these highly polymerized organic compounds are thrown out of the solution in the diluted sulfuric acid and re-dissolved in the oil, thus giving it a darker color than it had after the acid wash. This gummy "throw back" is not removed to any extent by the subsequent soda-wash, which does convert the sulfonic acids present to sulfonate soaps with their strong emulsifying tendency. After the final water wash the oil must be dried, usually by blowing air through it.

The clays used in the contact process of treating oils are aluminum silicates, colloidal in character and possessing an open structure that enables them to adsorb substances of high molecular weight. They are more effective than fuller's earth. The natural clay may be prepared for use by treating with hot diluted sulfuric (or hydrochloric) acid and regrinding. Some of the clays possess by nature such a structure that they do not require this opening out by acid, which removes calcium oxides and carbonates. The oil to be treated after the acid wash is placed in an agitator and agitated with a certain amount of the clay, at the same time being heated to from 70 to 120 degrees C. (158 to 248 degrees F.) depending upon the oil. After being held at the required temperature for half an hour the mixture passes to the filter press.

The clay has removed not only the acid tar and sulfonic acid, but the sulfonic acids and certain coloring matters as well, having a product with greatly reduced emulsifying tendency. The contact process is very useful not only in the original refining of a lubricating oil, but in preparing an oil which has stood for some time waiting for use in blending. An addition of ½ to 2 per cent of clay is sufficient and this will involve the loss of only about one-third as much oil. Applying the clay treatment to a finished lubricating oil greatly increases its stability to light and heat.

Bleaching Action of Fuller's Earth Upon Oils.—(*Keppler, Zeitschr. Angew. Chem.* 40 409 1927.) *Brit. Chem. Abs. -B. July* 8, 1927. *P.* 493.)—The increased bleaching action of fuller's earth after heating at 400 degrees is considered to be due also to organic constituents such as humus which are present in clays, although the amount may be so small that the color is unaffected, and to the decomposition by heat of organic colloids and consequent freeing of the surface. Kaolin treated with alkali to dissolve humus bleaches more efficiently than when untreated.

Wax Plant Operation

Heat of Solution of Paraffin Wax.—(*Sullivan, McGill and French. Ind. and Eng. Chem., Vol.* 19, *No.* 9, *pps.* 1040-41.) In calculations concerning refrigeration required for the chilling of wax-bearing distillates, 63.27 B.T.U. per pound is commonly used as the heat of solution of the wax. In making heat balances for refrigerating operations on wax distillate, discrepancies have been found which it was thought might be due to the use of this commonly-accepted 63.27 B.T.U. per pound. The heat of crystallization of the wax found in the wax distillate cut from Mid-Continent crude consequently was determined and was found to be 72.5 B.T.U. per pound. The apparatus and procedure used in obtaining this numerical figure are described in detail by the authors.

Loading

Loading Tank Cars With Volatile Liquids.—(*C. D. Greene. Chem. and Met. Eng., Vol.* 34, *No.* 10. *P.* 634.)—The device described below was designed for reducing evaporation losses while loading tank cars with gasoline. Figure 1 gives a systematic layout of the apparatus used. Variations to fit individual cases will be apparent to the reader. Exhaustive tests have shown that the ordinary method of loading through the open dome of the car entails an evaporation loss of over 20 gallons of gasoline per car loaded. This can be recovered by the use of gas-tight dome covers connected to a gas-recovery system, but the large percentage of air in the vapors and the corresponding low extraction yields do not usually warrant this expense except in very large installations.

As shown in the sketch, by extending the loading pipe to the bottom of the tank, the evaporation loss can be reduced

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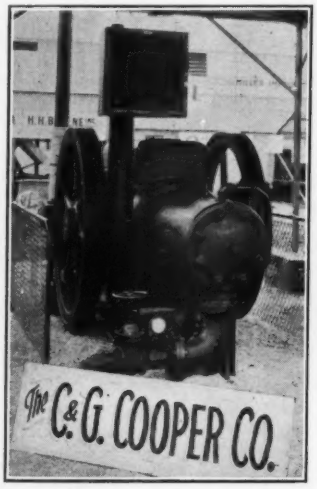

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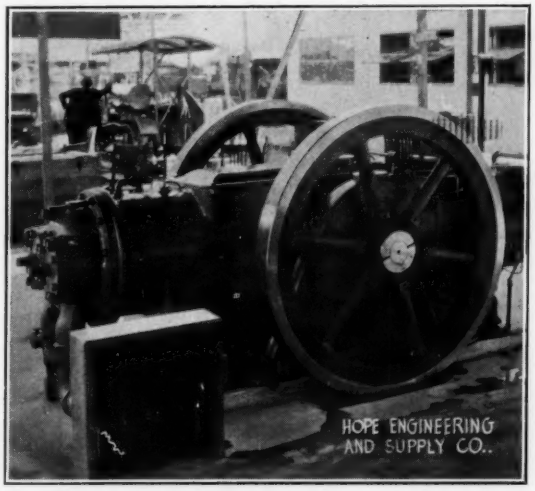

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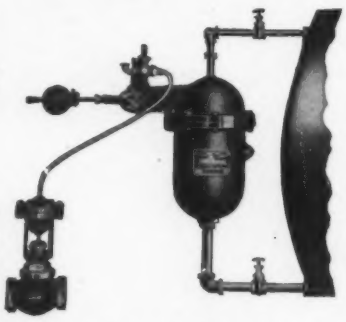

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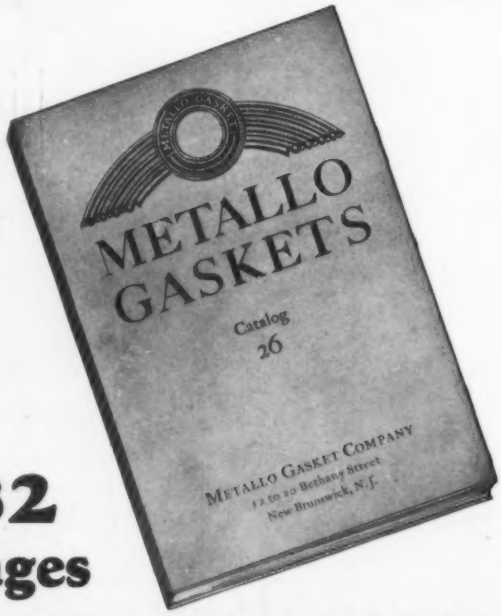

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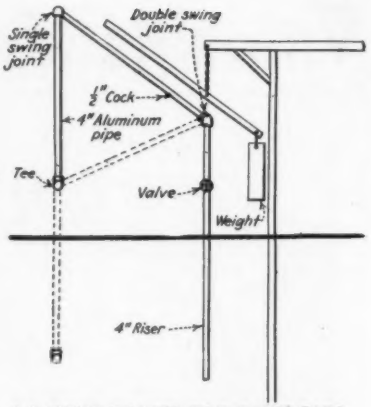


LOADING DEVICE FOR TANK CARS

to as low as five gallons per car. The use of four-inch piping for loading assures speed and little agitation in the car while loading. The four-inch tee on the end of the pipe prevents splashing by diverting the flow toward each end and the car instead of directly against the bottom. The tee and the pipe connecting it to the single swing-joint are made of aluminum and are standard fittings. This eliminates iron-to-iron contact and makes the whole apparatus much lighter than if iron piping were used entirely. The method of counterbalancing, as shown in the drawing, permits this size of pipe to be handled with ease. The counterweight is so arranged that the swing-pipe is counterbalanced in all positions. This means that little effort is necessary to raise the pipe from the track level to a position five or six feet above the tank car dome. It may also be swung horizontally through an angle of 300 degrees, so that cars on two adjacent tracks are reached by one riser. Cars can be reached that are spotted four and one-half feet off center. In other words, the train crew is allowed nine feet leeway in placing each car.

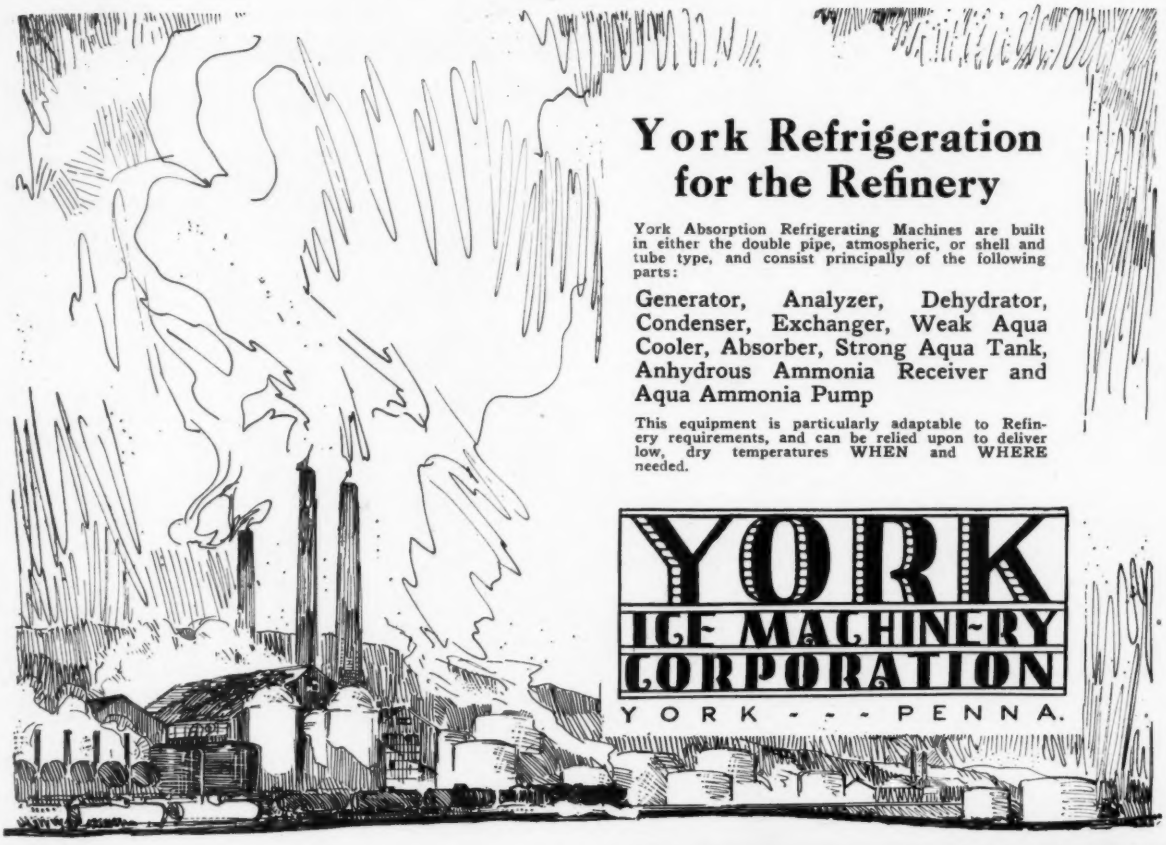
In actual practice it has been found convenient to overload the counterweight slightly, so that the pipe will rise of its own accord and remain high in the air out of the way. When loading, the tee on the end of the swing pipe need only be placed in the top of the tank car dome. When the gasoline is turned on, its weight is sufficient to lower the pipe to the bottom of the car. After the car is loaded the small ventcock is opened, allowing the pipe to drain. It then rises automatically to its former position, and is out of the way until it is needed again.

Another advantage of this design is the elimination of the static hazard. There is always positive metalic contact between car and pipe while gasoline is flowing, and there is no troublesome static wire to be lost, forgotten or mislaid.

FOR THE REFINER AND CHEMICAL ENGINEER

Equipment

Doulton Stoneware Centrifugal Pump.—(*The Industrial Chemist, Feb.*, 1927, 62. *J. I. P. April*, 1927. *Abs. No.* 202.)—This anti-corrosive pump has just been produced by Messrs. Doulton and Company,



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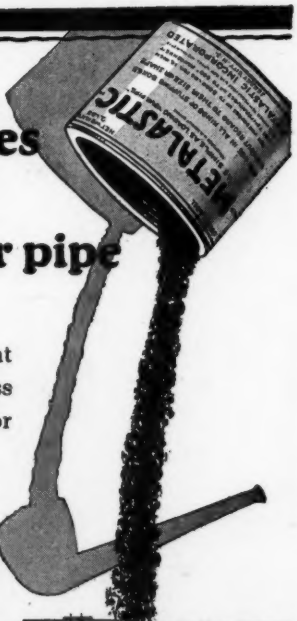

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Ltd., of Lambeth, and has several noteworthy points. Every detail of the pump, except the outer iron casing, is made of special acid-proof stoneware. The shaft is not specially mentioned, and therefore it is presumed that this is included in the details made of stoneware. The rotor is in the form of a disc with robust impellor blades projecting from one face and a series of small flat impellors on the opposite face, which sweep back any liquid tending to approach the gland and cause leakage. A cock is provided for draining the pump, and also an aperture for washing out. The pump may be supplied in six sizes, with outlets ranging from one and one-fourth inches to three and one-half inches diameter and capacities of from 1000 gallons per hour with the one and one-fourth-inch outlet to 10,000 gallons per hour with three-inch outlet and greater still with the larger size. The pump will work with ease against a head of water of 60 feet. It may be obtained directly coupled to an electric motor or arranged for belt drive with fast and loose pulleys mounted on Skefco ball bearings.

The Brunler Flame and Its Industrial Application.—(*Brunler, Ind. Chem., May,* 1927. *Jour. Inst. Petr. Techn., June,* 1927, *Abs. No.* 348., *in part.*)—The Brunler flame burns when submerged in water and has been adapted for use in industrial operations. Essentially the apparatus consists of a water-cooled burner which is fed with fuel under pressure and the theoretical quantity of compressed air.

In using the Brunler flame for steam-raising it is burned in a boiler below the surface of water; the steam and gases pass off and may be superheated by a second burner; dissolved impurities in the water settle out and form a sludge on the bottom of the boiler which can be drawn off from time to time.

As the temperature of the flame is about 1800 degrees C., complete combustion takes place, all carbon monoxide being burned. The steam-gas mixture consists of 50 per cent steam and 50 per cent carbon dioxide and nitrogen, and gives the highest efficiency when highly superheated.

The advantages of the flame for steam raising over the usual boiler are economy of fuel, in that complete combustion takes place, and the fact that there is no scaling of boiler plates.

The flame has been successfully used for the concentration of waste sulphite liquor and sewage liquors. In both cases the residues make quite good material for use in producer-gas plants for supplying gas fuel for the burner. Zinc-chloride solutions have been concentrated, although slight decomposition seemed to take place as the boiler plates became coated with a deposit of zinc.

Calculations

A Slide Rule for Solution of Problems in Flow Through Orifices.—(*Schnetzler. Ind. and Eng. Chem., Vol.* 19, *No.* 9, *pps.* 1027-29.)—In testing oil refinery equipment it is often necessary to measure the flow of liquids or gases in lines where no measuring device is already installed. In many of these cases the simplest and most quickly installed device for measuring the flow is the sharp-edged orifice flow-meter. The condition under which an orifice may be used and the relation between the pressure drop through the orifice and volume of flow are so well known that quite accurate results are obtained through its use. On account of its accuracy and simplicity, it serves as a useful tool in checking refinery operations. In order to save time and to eliminate errors in calculation of results of orifice measurements, a slide rule was devised by the author for making the necessary calculations. The slide rule is described. This slide rule may be obtained for 25 cents from F. W. Padgett, University of Oklahoma, Norman, Oklahoma.

A Critical Analysis of Equations for the Design of Fractionating Columns.—(*Shirk and Montanna. Ind. and Eng. Chem., Vol.* 19, *No.* 8, *pps.* 907-11.)—The various proposed rectification equations were subjected to critical analysis. The method of McCabe and Thiele was found by the authors to be the most practical and accurate for use in column design. An apparatus was designed to secure the data necessary for a comparison of the methods of calculation of the number of plates required for a given separation. Data showing the over-all efficiency of a bubbler-cap plate column with alcohol-water mixtures under various conditions were obtained. The criticism of mathematical methods that assume continuous instead of stepwise conditions has been shown to be justified.

Specific and Sensible Heats of Petroleum Oils.—(*Wilson. Ind. and Eng. Chem., Vol.* 19, *No.* 7, *pps.* 824-25. *Libr. Bull., U. O. P. Co., Vol.* 2, *No.* 28, *p.* 224.)

Fortsch and Whitman in Ind. Eng. Chem. 18, 795 (1926) gave a formula for specific heat of hydrocarbon oils

$$c = \frac{(t + 670)\quad (2.10 - g)}{2030}$$

which Wilson has here reduced, by transposed by taking logarithms of both sides, to a form from which he has drawn a chart making it possible to read off specific heat directly, the temperature and gravity of an oil being known.

The sensible heat absorbed or rejected by an oil in a process is the figure more likely to be required in petroleum engineering than specific heat. It is found by multiplying the specific heat at the average of the initial and final temperature by the total rise in temperature; or, by subtracting the sensible heat at the lower temperature from that at the higher. The sensible heat between 0 degrees F. and the temperature t is the specific heat integrated over that temperature interval:

$$h = \int_0^t \frac{(t + 670)\quad (2.10 - g)}{2030}\, dt.$$

Integrating, transposing, and again taking logarithms of both sides gave an equation from which a chart was drawn making it

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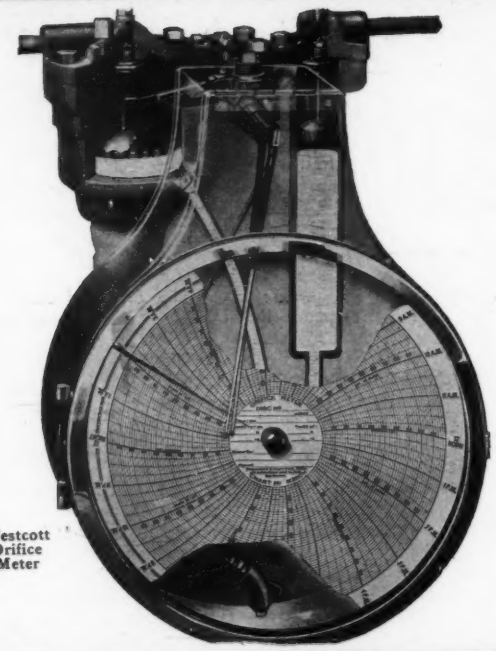

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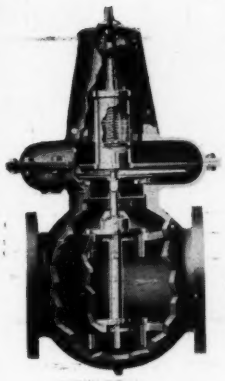

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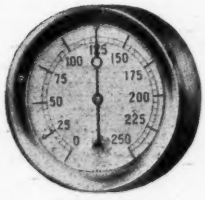

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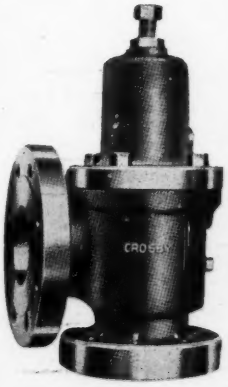

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possible to read off sensible heats directly.

Examples are given illustrating the use of the charts.

Heat Transfer

Heat Transfer of Oils and Water in Pipes.—Morris and Whitman. Abstract of paper read at the Detroit meeting of the A. C. S., Sept. 5-12.)—Film co-efficients of heat transfer have been determined for three petroleum oils and for water flowing through the tube of a double-pipe heat exchanger. The experiments cover both heating with steam and cooling with water under similar conditions.

The flow was in the turbulent or semi-turbulent regimes. Linear velocity varied from 1 to 20 feet per second, viscosity ran from 0.5 to 55 centipoises and the heat transfer co-efficients on oil covered a range from 10 to 700 B.T.U. per hour per square foot per degree F.

The data for oils and water can be correlated on the basis of Bouissinesq's theoretical equation, which states that the heat transfer coefficient is a function of the velocity, viscosity, density, thermal conductivity, specific heat, and pipe diameter, arranged in dimensionless groups. The quantitative conclusions are expressed graphically, since no simple equation has been found that will apply over the whole experimental range.

Physical properties of the liquid are taken preferably at the temperature of the main body of the liquid rather than at the customary film temperature. On this basis the cooling coefficients fall about 20 per cent lower than those for heating.

The results from heating water with steam agree closely with those published by other investigators. Data on other cases are not available for comparison.

Corrosion

Corrosion in Petroleum Distillation Plant.—(Freund. Chem. Ztg. 51 528(1927) *Brit. Chem. Abs. -B, Sept.* 2, 1927, P. 642 The corrosion of the iron valves and condensing columns of the apparatus used in distilling crude petroleum with steam may be due to two causes—the presence of chlorides in the emulsified water in the oil and the production of a large volume of carbon dioxide by partial oxidation of the unsaturated hydrocarbons in the oil. The latter is due to entrapment of air in the steam used or to leakage of air into the apparatus. Thus, in the distillation of crude benzine from Boryslav petroleum at 400 degrees, the uncondensed gases contained as much as 2.5 per cent of carbon dioxide and the issuing water from the apparatus contained 4 kg. of of iron per 100 m. 3 of oil distilled, partly as chlorides and partly as ferrous hydrogen carbonate. To avoid these troubles addition of lime or dilute alkali solution is recommended, together with the use of air-free water in the boilers.

OF PARTICULAR INTEREST TO THE CHEMIST

Laboratory Fractionating Column.—(Hill and Ferris. Ind. and Eng. Chem., Vol. 19, *No.* 3, *pps.* 378-82.)—The popular designs of laboratory fractionating columns are shown to have lower efficiencies than packed columns of the Hempel type with selected packings. The Snyder floating ball column and the packed column with iron jack-chain show up surprisingly well in a comparison of efficiencies. The superiority of the Snyder over the jack-chain is so small that the elaborate glass blowing for the former is scarcely warranted. A method is described which may serve for an accurate comparison of efficiencies in further similar work.

Measurement of Knock Characteristics of Gasoline in Terms of Standard Fuel.—(Edgar. Ind. and Eng. Chem., Vol. 19, *No.* 1, *pps.* 145-46.)—No method is known at present for any absolute method of measuring the knock characteristics of fuels. All methods consist essentially in comparing the performance of two different fuels. It is highly desirable that a reproducable standard fuel be developed to serve as a primary standard, thus permitting a comparison of the results of different laboratories and different experimental methods. It is possible by mixing normal heptane and a new synthetic octane to supplicate the knock characteristics of any commercial gasoline. It is proposed to utilize these mixtures as primary standards in rating the knock characteristics of fuels.

Quantitative Anti-Knock Testing.—(Reiman. Ind. and Eng. Chem., Vol. 19,

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No. 9, pps. 1055-58.)—The method of measuring the anti-knock quality of motor fuels developed in the laboratories of Arthur D. Little, Inc., where it has been in constant use for more than a year, is explained in detail. The Delco unit, after certain changes in the field wiring, serves as a dynamometer. Speed, a very important factor in determining quantitative results, can be positively controlled electrically. Results are reported in percentage aniline added to a paraffine base fuel serving as an intermediate standard. This standard is provisionally placed on Edgar's absolute heptane-octane scale.

Provided there is but little difference in anti-klock value between the unknown sample and the known aniline standards used in the final comparison, it is shown that the same result is obtained whether the comparison is made at high or low speed, high or low compression, high or low power output, with heavy or light knocking, rich or lean mixture, and regardless of the timing of the spark. Quantitative results on a series of fuels are included.

A Laboratory Method of Determining the Starting Properties of Motor Fuels.—(*Lovell, Coleman and Boyd. Ind. and Eng. Chem., Vol. 19, No. 3, pps. 389-94.*)—One of the most important properties of a motor fuel is the ease with which engines may be started on it. The starting characteristics of any given fuel are a complex function of its physical and chemical properties, and of the temperature of its mixture with air. Hence, the starting characteristic is a property which can not be determined accurately from conventional distillation curves, or from dew points and similar measurements.

Ease of starting may be determined directly in an engine, of course, when proper means are provided for controlling conditions. But since a large amount of equipment is needed for such a test, an attempt has been made to devise a laboratory method of determining the readiness with which an explosion may be obtained with any given fuel at the temperatures desired. This method consists in measuring directly the air-fuel ratio necessary to produce an explosive mixture at any given temperature. It has been applied to the testing of a considerable number of fuels of widely different properties, over a broad temperature range, and has been found to yield results that are comparable with those obtained io starting tests on actual engines.

Extraction of Amorphous Wax From Laboratory Specimens of Oil.—(*Bowrey. Jour. Soc. Chem. Ind., June 17, 1927, P. 228 T.*)—It is sometimes necessary in order to forecast the result of a scheme of refining to remove the amorphous wax from a sample of oil. This can be done conveniently by chilling the oil in a triple-walled unsilvered vacuum flask by the evaporation of liquid sulphur dioxide placed in the inner jacket next the oil. The oil is mixed with one and one-half vols. of petroleum naphtha and placed in the flask. The inner jacket, half-filled with sulphur dioxide, is connected to a vacuum pump, and evaporation is so controlled that convection in the oil is entirely avoided. This is essential in order for the wax to settle. If the quantity of wax is large, the cooling must be done in stages, to permit it to settle. If it is necessary to recover a maximum of the oil, the wax may be washed by decantation with naphtha chilled to the same temperature. By settling at 20 degrees F., oil may be obtained having a cold test of 25 to 30 degrees C.

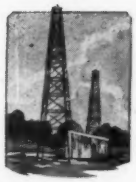
Direct Refractometer Method for Determination of Oil in Paraffin Wax.—(*Diggs and Buchler. Ind. and Eng. Chem., Vol. 19, No. 1, pps. 125-127.*)—For refined and semi-refined waxes, the index of refraction (140°F.) of the sample is determined. Approximately 50 grams is filtered through 50 grams of Attapulgus clay and the index of refraction of the "oil-free" filtrate is obtained. This value represents the zero per cent oil point of a curve of index of refraction versus per cent oil. A wall chart has been constructed having a movable brass arm shaped to this curve and pivoted at the 100 per cent oil point. The movable end is set at the zero per cent oil point as determined above, and the per cent oil corresponding to the index of refraction of the sample is read directly from the lower edge of the arm.

Prediction of Flash Point of Blends of Lubricating Oils.—(Thiele. Ind. and Eng. *Chem., Vol. 19, No. 2, pps. 259-262.*)—A method is presented for calculating the flash point of any ordinary mixture of lubricating oils when the flash point of the counstituents is given. The method is rapid and simple in application. While it is probably not extremely accurate, the experimental evidence presented indicates that, when applied to a wide variety of commercial lubricants, it gives correct results to about the degree of accuracy attained in flash point determinations. The theoretical basis for the method is also discussed briefly.

Petroleum Research and Experimental Work

The Chemistry of Gasoline (Particularly with Respect to Gum Formation and Discoloration.)—Brooks. Ind. and Eng. Chem., Vol. 18, No. 11, pps. 1198-1203.)—The first step in the formation of gum in cracked gasolines is the formation of organic peroxides. These break up in a complex manner, with the formation of aldehydes, ketones, including formaldehyde, water, carbon dioxide and further oxidation to organic acids. The fluid gum observed in gasoline consists mostly of organic peroxides and fluid aldehydes and ketones; old, fully-oxidized resin, after expelling volatile products, is resin acids, not aldehyde condensation products. Small proportions of easily oxidizable hydrocarbons, such as diolefins, promote the formation of large proportions of gum. Oxidation of ordinary olefins with "gum" formation also occurs, but at a very much lower rate.

The most common cause of the discoloration of gasolines and kerosenes is the development of a trace of acidity. Sulfur dioxide and its oxidation to sulfuric acid is the most common cause of this acidity. The known oxidation of mercap-



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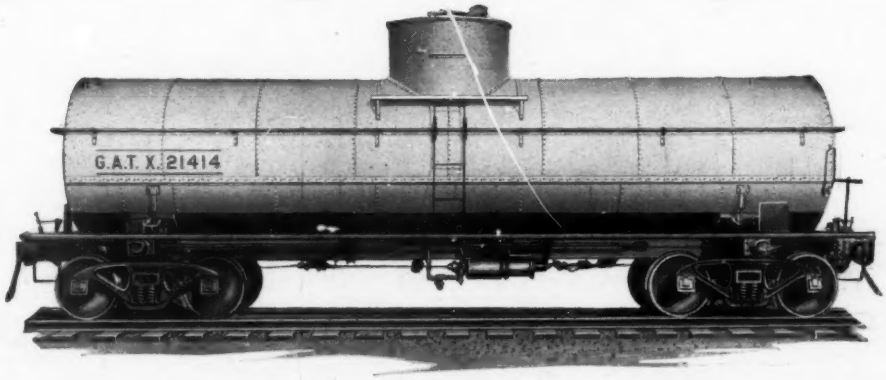

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tans and alkyl disulfides to sulfonic acids may also cause discoloration. Gasolines that have not been acid-treated may develop acidity and discoloration. The function of steam in re-distilling acid-treated cracked gasolines is to take up the sulfur dioxide formed during distillation. Alkalies or oil-soluble bases prevent discoloration by developed acidity.

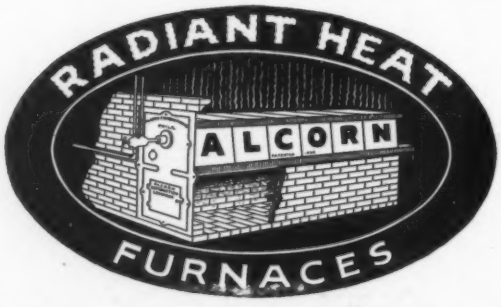
Gaseous Explosions: Effect of Fuel Constiution on Rate of Rise of Pressure (III)—Brown and Watkins Ind. and Eng. Chem., Vol. 19, *No.* 2, *pps.* 280-85.)—Apparatus suitable for the quantitative determination of the rate of rise of pressure of a gaseous explosion is described. Normal hexane, heptane and octane; benzene, toluene and xylene; methyl, ethyl and amyl alcohols and ethyl ether were used to prepare explosive mixtures with substantially theoretical oxygen and nitrogen. These mixtures were exploded under constant initial conditions and the pressure-time curves were graphically differentiated to obtain the maximum rate of rise of pressure. Comparison of the data so obtained indicates that the rate of rise of pressure in a progressive homogeneous reaction (one in which the flame moves progressively through the explosive mixture) increases with molecular weight in the paraffin series, varies inversely with the number of methyl groups added to the benzene ring in the aromatic series, and is about the same for the higher alcohols as for the corresponding paraffin hydrocarbon.

Gaseous Explosions: Rate of Rise of Pressure, Velocity of Flame Travel and the Detanotion Wave. (IV).—Brown and Watkins. Ind. and Eng. Chem., Vol. 19, *No.* 3, *pps.* 363-66.)—Velocity of flame travel and rate of rise of pressure are shown to be similar and vary in the same way with changing initial conditions. Detonating mixtures of pure liquid fuels and sustantially theoretical oxygen were exploded with varying amounts of nitrogen in the constant volume bomb. The amount of nitrogen necessary to reduce the intensity of the detonation to an arbitrary standard was found to carry directly as the rate of rise of pressure. These data lead to the conclusion that the rate of rise of pressure upon explosion of a fuel mixture is the major factor indicating the tendency of that fuel mixture to set up the detonation wave in a progressive homogeneous reaction, and that engine knock is not due to a detonation wave as recognized in progressive homogeneous explosions.

Gaseous Explosions: The Probable Mechanism Causing "Detonation" in the Internal Combustion Engine (V).—*(Brown and Watkins. Ind. and Eng. Chem., Vol.* 19, *No.* 3, *pps.* 366-69).—It is well-known that hot surfaces in the combustion chamber of an engine increase the tendency to "knock", indicating that engine knock is caused by a heterogenous reaction on the heated surfaces. It was found that if the maximum rate of rise of pressure as determined in a progressive homogeneous reaction under constant initial conditions be divided by the autoignition temperature on the absolute temperature scale, a number is obtained which varies directly as the knocking tendency of that particular fuel in an engine, or inversely as Ricardo's "highest" useful compression ratio for that fuel. This fact suggests rate of rise of pressure and autoignition temperature as the two factors determining the tendency of fuels to knock in an engine; and autoignition of the unburned mixture adiabatically compressed against hot surfaces as the mechanism causing "fuel-knock" in an internal combustion engine.

Evaluation of Turbine Oils.—(Rogers and Miller. Ind. and Eng. Chem., Vol 19, *No.* 2, *pps.* 308-12).—The deterioration which turbine oils undergo in service is due to oxidation. This oxidation was studied by the authors, who developed a test in which the oil suffers in relatively short time changes that parallel those in actual service. Oxidation is carried out at 210 degrees F. in the presence of iron, and determinations of acidity, Herschel emulsibility and sludging time serve as the criteria in evaluating the quality of the oil. Comparisons between laboratory tests and test runs in plant turbines are given.

The Petroleum Waxes.—(Buchler and Graves. Ind. and Eng. Chem., Vol 19, *No.* 6, *pps.* 718-24.)—Paraffin, slop wax, petroleum wax and rod wax were separated into a series of pure fractions belonging to the same homologous series of paraffin hydrocarbons ranging from $_{31}H_{38}$ to $C_{53}H_{56}$. Photomicrographs show that each



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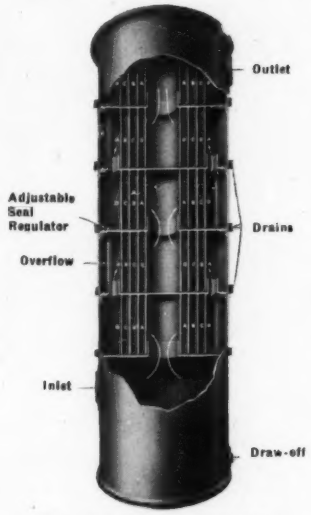

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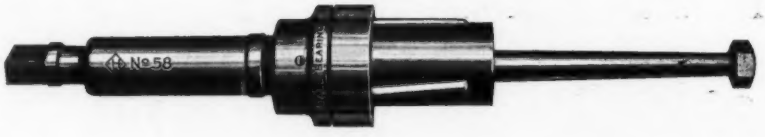

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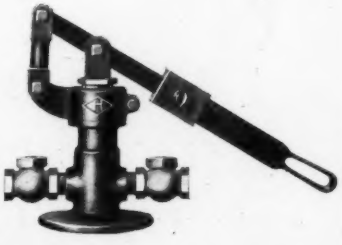

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NEW PRODUCTS

The Voltol Lubricating Oils.—(Petr. Times, Aug. 20, 1927, *p.* 350)—The Voltol oils have so far been manufactured commercially only in Germany. An article by Grossman in Allgem. Osterr. Chemiker u. Techniker Zeit., states that these products are made by subjecting vegetable or mineral oils to the reaction of electricity in the form of the silent discharge at high voltage with the electrodes in direct contact with the oil being treated. The oil compounds are decomposed and reformed into new ones. Berthelot was the first to experiment in this way and used for the purpose carbon monoxide, carbon dioxide, methane, acetylene, and ethylene. De Hemptinne next found that he could thus make good lubricants, and took out some patents.

After the war Eichwald and Vogel pushed investigation farther to the point of some commercial success. Their electrodes are said to be made of pasteboard and aluminum and revolve in a horizontal cylinder containing the oil. The electrode surface for each cylinder is about 600 square meters. The Voltol oils are highly viscous and stable. The temperature coefficient of viscosity is smaller than for other oils and for this reason Voltol oil was used for the airship ZR 3 sent from Germany to America, and for the Norge in which Amundsen made his North Pole flight. The new oils, combined with ordinary less-viscous lubricating oils, give a lubricant which is especially suitable for internal-combustion engines, super-heated-steam cylinders, high-pressure compressors, and wherever a heavy-duty oil is needed. They also give good results with variable speeds and loads.

NATURAL GASOLINE INDUSTRY

Manufacture of Amyl Acetate from Natural Gasoline—(Koch and Burrell. Ind. and Eng. Chem., Vol 19, *No.* 4, *pps.* 442-45. *Libr. Bull, U. O. P. Co., Vol.* 2, *No.* 15, *pps.* 106-7.)—There are three steps in the process of synthesizing amyl acetate from the pentanes in natural gasoline:

(1) Fractionation of pentane from natural gasoline.

(2) Treatment of pentane with chlorine, obtaining chloro-pentane or amyl chloride.

(3) Combining amyl chloride with sodium acetate to give the ester, amyl acetate.

For recovery of pentane from natural gasoline a steam-jacketed, copper-lined, continuous restifying still is used and the fraction coming over between 25 degrees and 40 degrees C. (77-104 degrees F.) is separated out. Chlorination is accomplished by passing chlorine up through a percolator contained in a larger tube filled three-quarters full of pentane and containing a catalyst, as active carbon or silica gel, capable of absorbing large amounts of chlorine. Activated carbon giving a 12-15 min. chlorpicrin test produces the best results. The chlorinated hydrocarbons are washed and fractionated to recover the amyl chloride, which is contained in the fraction coming over between 90 degrees and 110 degrees C. (194-230 degrees F.)

In order to convert the amyl chloride to the acetate without a large portion of the amyl chloride breaking up into amylene and hydrochloric acid, it proved to be necessary to eliminate all moisture from the reactants end to use charcoal as a catalyst. The amyl chloride is charged to a jacketed autoclave provided with a stirrer and to it is added 65-75 parts by weight of pulverized sodium acetate together with one-half parts of solvent. The water in the jacket is kept at 400-450 degrees F., with a corresponding gage pressure of 200-250 pounds. About eight hours at maximum heat is required for a run. The esterified product is washed and fractionated, a technical grade of amyl acetate being obtained in the cut between 120 and 175 degrees C. (248-347 degrees F.) This has a sp. gr. at 15 degrees C. (59 degrees F.) of 0.88; light yellow color; acidity, 0.196 per cent acetic acid; I.

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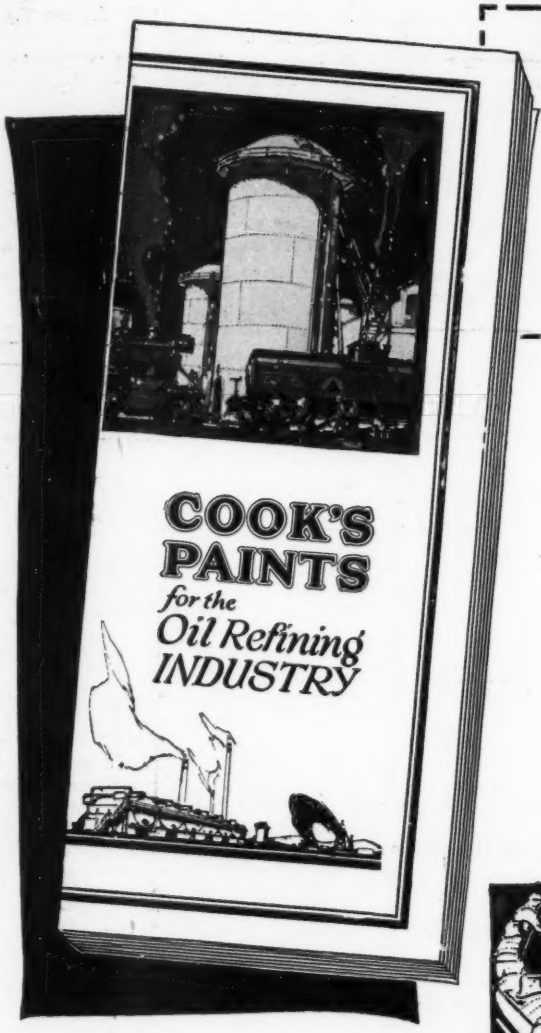

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Gasoline from Natural Gas.—(*Petr. Times, April* 23, 1927, *p.* 752).—The stripping of gasoline from natural gas prevents the trouble formerly caused by the condensing of the gasoline in the pipe. *Natural Gas* states that when three gallons of 90-gravity natural gasoline per 1000 cubic feet is removed by absorption from natural gas having a specific gravity of 0.70 and calorific value of 1200 B.t.u., the reduction in volme is 0.80 per cent, in specific gravity, 2.2 per cent, and in heating value, .2 per cent. If this gasoline had not been recovered, about half of it would have been lost in the line, and the above losses would have appeared as gains to the consumer of only 0.4, 1.1, and 1 per cent, respectively. It has been ascertained that a natural gas with high gasoline content has a higher heat value after stripping than a natural gasoline with low gasoline content after this has been removed by an equally efficient method.

Water vapor is removed with the gasoline. The saturation value at 70 degrees F. and atmospheric pressure is 2.5 per cent of water vapor in the gas. If in gasoline recovery the water vapor is reduced to 0.07 per cent, the volume of natural gas is reduced by 1-18 per cent, and the heating value is increased by 1.19 per cent, which would completely offset the heat units lost by the extraction of 0.2 gallons per 1000 cubic feet of 90-gravity gasoline.

The general practice in England is to sell gas on its thermal value rather than by volume.

Phillips Will Enlarge Panhandle Plant

Amarillo, Texas.—The purchase by Phillips Petroleum Company of the 2250 barrel daily capacity skimming plant of the Alamo Refining Company at Borger, located in the Hutchinson County field, will be followed by the establishment of a complete marketing organization in the Panhandle section of Texas. The new owners of the plant will also increase the capacity to 7500 barrels daily, and operate on 35-39 gravity oil being produced in Hutchinson County by Phillips Petroleum Company. The posted price for this crude is 75 cents per barrel, and it was this low price that forced Phillips into the refining branch.

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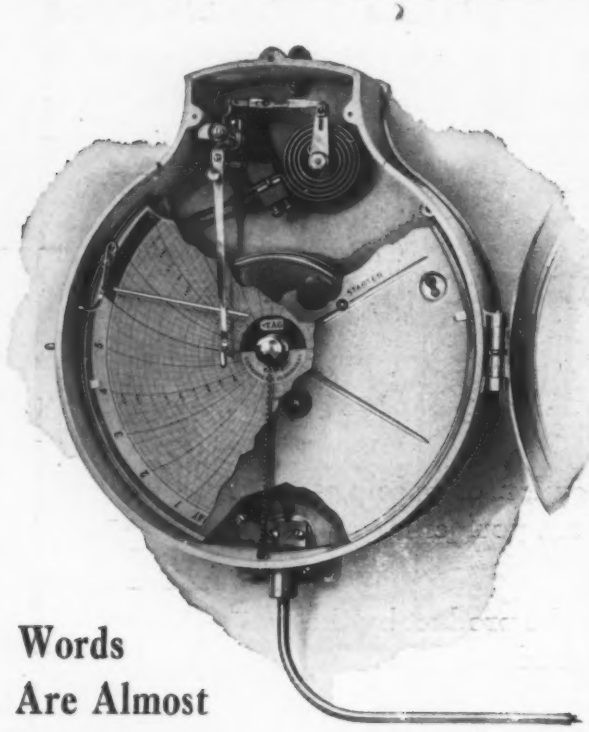

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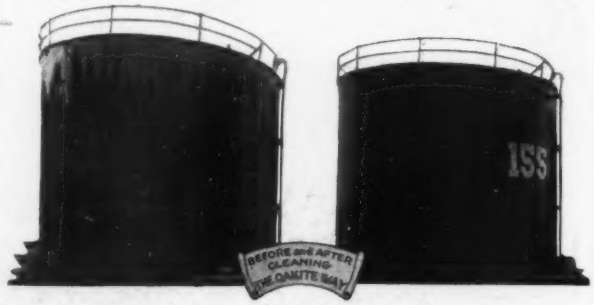

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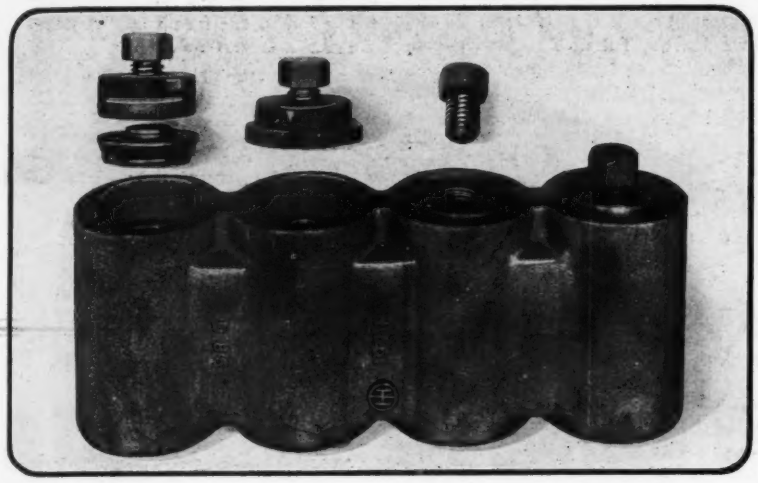
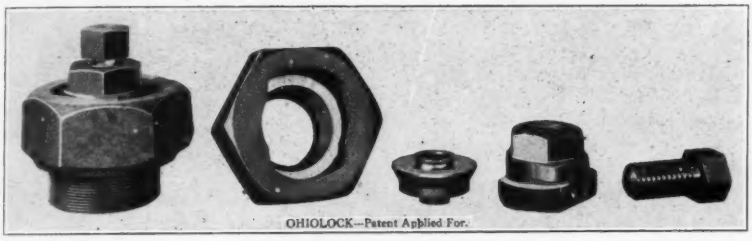
NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS





THE OHIO LOCK PLUG

New Ohiolock Plug

OHIO STEEL FOUNDRY COMPANY

The Ohio Steel Foundry Company, Lima, Ohio, announces the Ohiolock Plug, new equipment of interest to refiners.

The plug was developed as a means of reducing to a minimum the amount of time required to shut down the stills and clean out the tubes.

The plug is furnished either as part of the return bend or as a replacement.

The plug itself consists of three parts: The valve with a ground seat, the set collar, and the set screw.

To apply the plug to the return bend means inserting it in the bend, giving it a quarter turn to the right, locking it in place and then tightening up the set screw.

When locked in place, the positive action of the plug keeps it from loosening up.

More information will be mailed on request to the company.

Organize New Firm

A new firm entering the manufacture of absorption plant and refinery equipment is the Engineering, Research and Equipment Company of Los Angeles. A branch is to be opened in Tulsa to serve the Mid-Continent territory.

The organizers, men well known in the industry, are I. B. Funk, consulting engineer; J. E. Kobernik, formerly general manager of the Newton Process Manufacturing Company; and Paul Raigorodsky, formerly efficiency engineer for Newton Process Manufacturing Company.

I. B. Funk is vice-president of the California Natural Gasoline Association, and has been connected with the petroleum industry in various capacities, the major portion of the time, for 25 years. During seven and one-half years with the Union Oil Company of California, he had, for six years, charge of the research work pertaining to gasoline plants and field operations. Since leaving the Union Oil Company in 1926, he has been engaged in consulting engineering practice.

J. E. Kobernik has had a wide experience in manufacturing. He was with the New York Central Shops as layer out, and later as boiler inspector. Coming to California during the War he entered the employ of the General Petroleum Corporation in charge of shops; then to the Standard Oil Company in charge of shops. In 1922 he started the Santa Fe Springs Welding and Boiler Shop which was later incorporated as the Newton Process Manufacturing Company.

P. M. Raigorodsky served two years in the War and is a United States Reserve Officer. His training was at the University of Prague, graduating from the University of Texas. He has had a wide range of experience in the supervision and operation of gasoline absorption plants and efficiency work.

I. B. FUNK

PAUL M. RAIGORDSKY

J. E. KOBERNIK

Sarco Steam Traps

SARCO COMPANY, INC.

Sarco Company, Inc., 183 Madison Avenue, New York, is now marketing Sarco Heavy Service Steam Traps, recommended for rapid discharge of heavy condensation.

The traps are of the multiple unit type. A number of Sarco motor elements are attached to a screwed disc in the bottom of the trap. When heated by steam, they expand and lift a plate to which the valve head is attached. This closes the trap which remains closed until condensation is ready to be discharged. The lower temperature results in contraction of the motor elements and the trap opens.

More information will be supplied on request to the company.

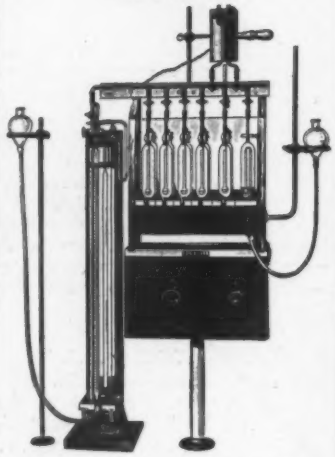
The Electric Controller and Manufacturing Company is now supplying its standard type ZO Across-the-Line Starting Switches for small AC motors. The switches are in ironclad tanks which make them suitable for operation in atmospheres where acid fumes are present. All the contacts in this switch open and close under oil so that the starter is flame-proof.

A machine fit between the cast iron cover and the tank makes the starter rain-proof.

BURRELL

De Luxe Safety Model

Standard-Burrell Gas Apparatus For the Gas and Oil Industries



Completely Described in the New BULLETIN NO. 750

A copy will be sent upon request.

Burrell Technical Supply Co.

CHEMICAL-BIOLOGICAL-METALLURGICAL LABORATORY APPARATUS AND REAGENTS

1704-1708 FIFTH AVENUE PITTSBURGH, PA.

Move Factory

Tulsa, Okla.—The Mid-Continent factory of the Southwestern Engineering Corporation, has been moved from North Rockford Street to the Dawson road and Harvard street, Tulsa. The quarters consist of two large bays of the newly completed factory of the Vulcan Steel Corporation, where a complete welding and assembly shop will be maintained under the supervision of George Kelley. About 50 pieces of equipment will be kept in stock for rush deliveries to both the refining and natural gasoline fields.

The mining and metallurgical department of the concern has been moved from Joplin, Missouri to Tulsa. A warehouse will be maintained in Joplin.

These changes have made it necessary to take larger office quarters in the Mayo building. R. B. Millard is Mid-Continent district manager for the concern, handling all territory between New Mexico and Ohio.

The Henszey De-Concentrator Company of which D. H. Skeen and Company is agent, has recently published a new bulletin on the Henszey Continuous Blowdown system.

Briefly stated, the operation of the system consists of withdrawing or blowing off the concentrated impure water from the boiler and substituting fresh water instead, at the same time transferring all of the heat from this blowoff to the feed water.

The device operates automatically at all times when cold make-up water is being fed to the feed water system.

More information will be mailed on request to the Henszey De-Concentrator Company, D. H. Skeen and Company, General Agents, 53 W. Jackson Boulevard, Chicago.

The Mathieson Alkali Works, Inc., announces the purchase of the B. P. Clapp Ammonia Company, covering the activities formerly conducted by this company, at Cincinnati, Louisville, Washington and Providence.

The B. P. Clapp Company was one of the earliest manufacturers of Ammonia in the United States.

Take Over Refinery at Brownwood

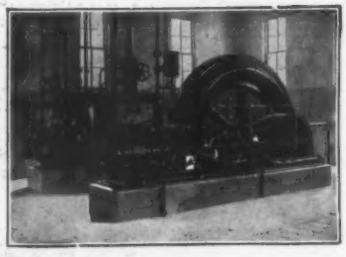
Brownwood, Texas. — The Central Texas Refining Company has been organized with a fully paid in capital stock of $25,000 to take over and operate the Patterson plant, located in Brownwood. The plant is being re-conditioned, and will have a daily capacity of 750 barrels. Headquarters of the Central Texas Refining Company are at 1901 Fisk Street, Brownwood, Texas. The officers of the company are: John S. Owens, Brownwood, president; E. T. Green, Brownwood, vice-president; C. A. Middleton, Corsicana, secretary-treasurer; and George Mann, plant superintendent. Crude will be obtained from nearby fields.

L. W. Fought Dies

Tulsa, Okla.—Leland W. Fought, resident engineer of the E. B. Badger & Son Company in Tulsa, died here November 8 from pneumonia. He is survived by his widow, Esther S. Fought. The body was forwarded to Oak Harbor, Ohio, for burial. Mr. Fought was a graduate of the University of Michigan, class of 1924.

Vilter Ammonia Compressors Fittings and Pipe Coils

Render Years of Reliable Service



Compressors built in several types and a great variety of sizes. Illustration is of a moderate speed type compressor.

Complete Data on Request

THE VILTER MFG. CO.

Established 1867

1152-1162 Clinton St. Milwaukee, Wis.

BRANCH OFFICE
501 Washington Ave.
Houston, Texas

WANTED—Position as superintendent or assistant superintendent of refinery. Thoroughly familiar with all grades of oil, from Canada to the Gulf Coast, especially oils heavy with sulphur.

Address Box 2219, care Refiner and Natural Gasoline Manufacturer.

Electrically Driven Centrifuges
Hand Centrifuges
WRITE
WILLIAMS, BROWN & EARLE, Inc.
Manufacturers of Laboratory Apparatus
918 Chestnut St. Philadelphia, Pa.

BONER & SHELDON
Manufacturing Engineers
Fractionating Towers, Absorption Towers, Vertical Stills, Distillation Equipment.
514 Merchants National Bank Bldg.
Los Angeles, Cal.

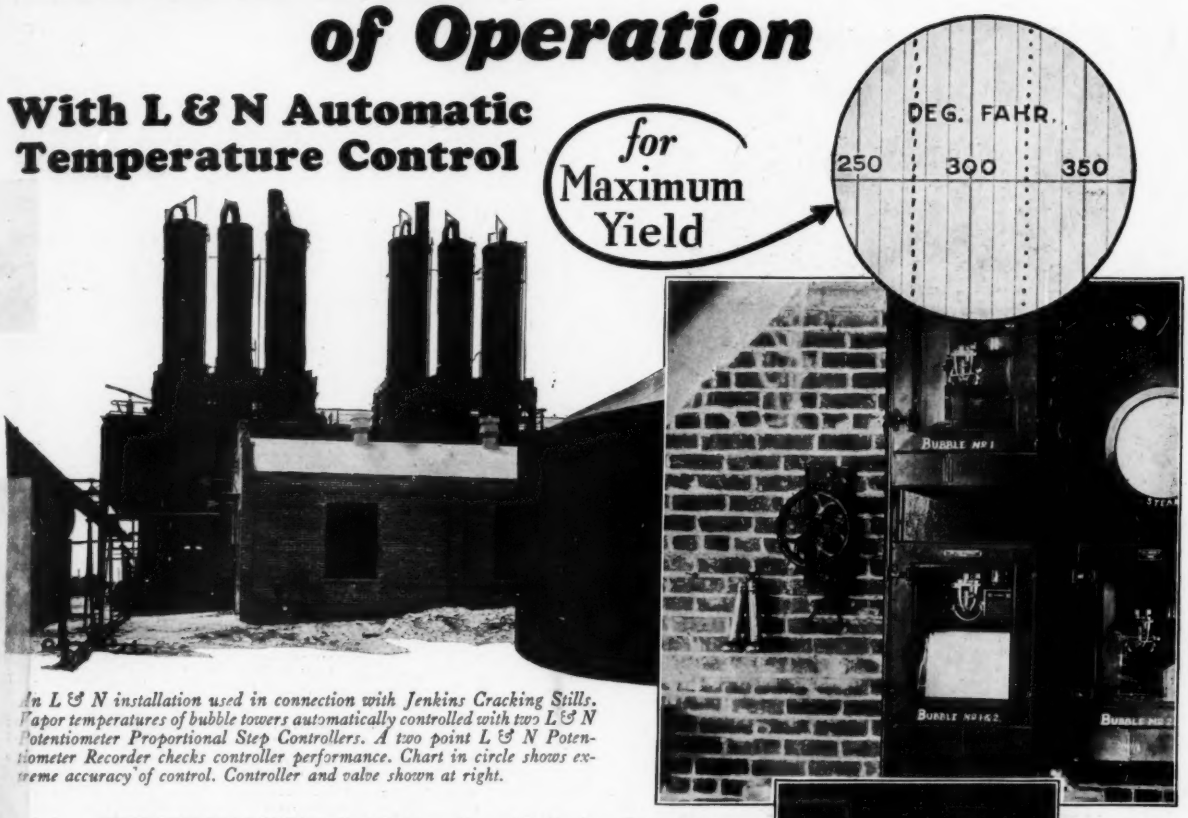
IDLE PORTABLE
SOUTHWESTERN EQUIPMENT
for Refineries and Gasoline Absorption Plants, Condensers, Heat Exchangers, Fractionators, Stills, Absorbers and Complete Plants priced to move.
W. F. PYNE,
909 So. Ardmore Ave., Los Angeles, Calif.

Mention Where You Saw the Advertisement

Steadiness of Operation

With L & N Automatic Temperature Control

for Maximum Yield



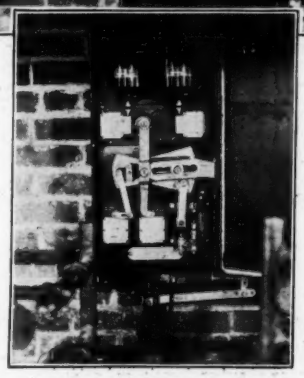
An L & N installation used in connection with Jenkins Cracking Stills. Vapor temperatures of bubble towers automatically controlled with two L & N Potentiometer Proportional Step Controllers. A two point L & N Potentiometer Recorder checks controller performance. Chart in circle shows extreme accuracy of control. Controller and valve shown at right.

ESPECIALLY in oil refining, allowable limits of temperature are very close. Temperature pulsations in the coil outlet and vapor lines greatly reduce the yield.

Because of this, L & N Potentiometer Pyrometers are essential in all cracking processes, whatever the type of still. Steadiness of operation is made possible by the accuracy of the L & N Potentiometer Temperature Controller.

The Plant Engineer finds many uses for L & N Potentiometers. He uses them for recording and automatically controlling temperatures in his combustion chambers, in his continuous stills, his vacuum stills, his cracking stills, his coil outlet pipes. He also measures storage tank temperatures with these instruments.

L & N Potentiometer Pyrometers are different. They are extremely accurate and reliable, easy to read, unaffected by temperatures at all points except that being measured, and length of leads has no effect upon accuracy of reading.



Write for Bulletin 870-R

LEEDS & NORTHRUP COMPANY

ELECTRICAL MEASURING INSTRUMENTS

P75 PHILADELPHIA, PA.

BRANCH OFFICES: CLEVELAND, CHICAGO, HOUSTON, LOS ANGELES, SAN FRANCISCO

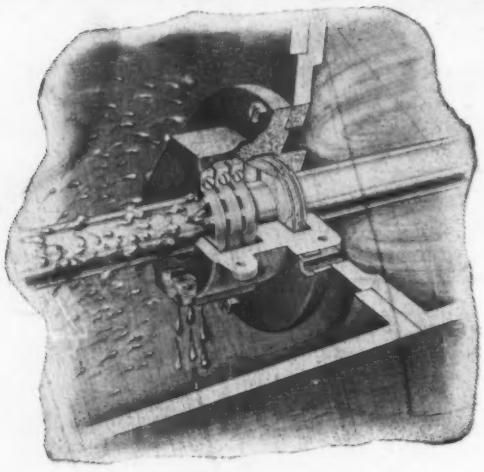
The L N

"Different from all others"

Potentiometer

most accurate • • PYROMETER • • in industry

STOP WASTING OIL



by using

Garlock Oil Return Packing

for

Gas Engines **Air Compressors**
Gas Compressors **Steam Engines**

of the

ENCLOSED CRANK CASE TYPE

Replace the inefficient Oil Wiper on your Gas Engine, Air or Gas Compressor or Steam Engine of the enclosed crank case type with Garlock All Metal Oil Return Packing. It will wipe every drop of oil from the piston rod and return it freely to the crank case. This packing is also designed to take care of vacuum and low pressure on certain types of power cylinders.

Savings Made by Installing Garlock Oil Return Packings

GAS ENGINES

1. Greatly reduces the amount of oil consumed.
2. Eliminates oil being deposited on discharge valves and valve chambers.
3. Checks discharge of oil through the exhaust.
4. Stops forming of carbon deposits and oxidation.

AIR and GAS COMPRESSORS

1. Greatly reduces the amount of oil consumed.
2. Eliminates oil being deposited on discharge valves, valve chambers, pipe lines and receivers.
3. Checks oil from being discharged by the cylinder into the compressed air and gas.
4. Stops the forming of carbon deposits and oxidation.

STEAM ENGINES

1. Greatly reduces the amount of oil consumed.
2. Stops the emulsifying of the lubricating oil.
3. Eliminates the inconvenience of having oil in exhaust steam where the steam is used for process work or radiation.

THE GARLOCK PACKING COMPANY

PALMYRA, N. Y.

Manufacturers of "Quality Controlled" Mechanical Packings

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Under the Microscope

The SECRET IS REVEALED

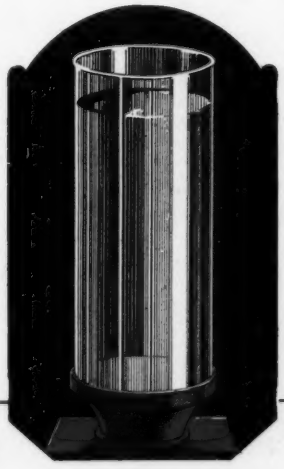
"Why is it your cylinders clean up so much easier than any other?"—is often asked of us.
Under the microscope, the inside of most cylinders that have been in use for some time show hills and valleys—the effect of "weathering" or pitting. The precipitation from gasoline fills up these "pits' and the cylinder itself takes on a yellowish tinge, which no amount of cleaning will remove. Displayed through such a cylinder, any gasoline will *appear* to have a yellow color.

No amount of usage—or passage of time—will cause deterioration in our cylinders. Under the microscope, their inner surfaces, even after years of service, will show up just as smooth, with the same high lustre and polish as when they first left our factory. That's the reason they can be cleaned perfectly—at any time.

That's one of the big reasons, too, why over 90% of all leading pump makers use cylinders made by the Hyatt Glass Company—the only manufacturer in America making pump cylinders exclusively.

Such preference must be deserved—and founded on merit—and merit alone.

"Super" Water Clear Cylinders Display any Gasoline Better



Both our "Water-Clear" and "Super Water-Clear" Cylinders are made under our secret formulas, which absolutely prevent "weathering" or "pitting' with age. They retain their lustre and highly polished surfaces indefinitely—and *do* display any gasoline to better advantage, bringing out all the sparkling brilliance of water-white gasoline, or the various colored gasolines.

We guarantee to replace, free of charge, any of our cylinders which weather, pit or discolor while used on a pump, within five years from its installation.

"Super Water-Clear" and "Water-Clear" Cylinders are available to ANY and ALL Pump Manufacturers. We invite inquiry from those who want the best cylinders for their product.

The Hyatt Glass Co.

Poteau, Okla.

WATER CLEAR

You lose *from* 2 *to* 8 barrels on *every* car loaded *without* a Universal Gastite Dome Cover. *Figure* the number *of* cars you load *each* year -multiply your loss *and* you will know *how much* actual cash *a* Universal Gastite Dome Cover *will save* you. One refiner *saved* $125,000 *in* 17 months/ *In* addition *they give* Positive Protection *against* inclement weather *and* eliminate danger of explosion~~~

EST. 1866 McDonald

Take advantage of these economies~ Write for full information

UNIVERSAL *Gastite Dome Cover*

PATENTED OCT. 14, 1924

A.Y. McDONALD MFG. CO.

Dubuque, Iowa

OMAHA MINNEAPOLIS DES MOINES KANSAS CITY

"The Home of the Swing Joint"

McDONALD